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Silvicultural Management of Riparian Areas For Multiple Resources

A COPE Workshop —

December 12–13, 1989
Salishan Lodge
Gleneden Beach, Oregon

ABOUT THE COPE PROGRAM

The COPE program is administered by the USDA Forest Service Pacific Northwest Research Station and Oregon State University's College of Forestry. COPE scientists and sponsoring organizations work cooperatively to solve specific natural resource problems in the Oregon Coast Range through research and education. The program is supported by funds from the USDI Bureau of Land Management, USDA Forest Service, forest industry, Oregon State agencies, county governments, US Fish and Wildlife Service, USDI Bureau of Indian Affairs, and the Oregon Small Woodlands Association. In addition to sponsoring research and publications, these contributions allow COPE to offer workshops at reduced rates.

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V. Panel Discussion

Speakers, Moderators, and Panel Discussion Members

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AGENDA

SILVICULTURAL MANAGEMENT OF RIPARIAN AREAS FOR MULTIPLE RESOURCES

Tuesday, December 12

8:00 Registration, Salishan Lodge

9:00 Workshop Background and Objectives - Tom McMahon, COPE and Oregon State University

9:10 Role and Management of Riparian Areas - An Historical Perspective
Jim Sedell, Pacific Northwest Research Station

SESSION I:

MANAGING RIPARIAN AREAS FOR FISH AND WILDLIFE HABITAT AND WATER QUALITY
Moderator: Tim Bozorth, Bureau of Land Management

9:35 The Effects of Riparian Vegetation on Sediment, Channel Morphology and Temperature in Streams - Bob Beschta, OSU Forest Engineering Dept.

9:55 The Effects of Riparian Vegetation on Light, Nutrient Cycling and Food Production in Streams - Stan Gregory, OSU Fisheries and Wildlife Dept.

10:15 Break

10:40 Large Woody Debris and Fish - Tom McMahon, COPE and Oregon State University; Gordon Reeves, Pacific Northwest Research Station

11:00 Riparian Wildlife Habitat Relationships - Bill McComb, OSU Forest Science Dept.

11:20 QUESTIONS

12:00 Group Lunch
1:00 Luncheon Speaker: Dave Bella, OSU Civil Engineering Dept.
"Working Within an Organization"

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Tuesday, December 12 cont.

SESSION II:
STRUCTURE AND DYNAMICS OF RIPARIAN VEGETATION
Moderator: Chal Landgren, OSU Forestry Extension

1:30 Ecology of Riparian Vegetation: The Biological Basis for Management - John Tappeiner, OSU Forest Science Dept.

1:55 Riparian Vegetation Characteristics, Geomorphology and Land Use in Coast Range Basins - Jim Kiser, OSU Forest Resources Dept.

2:20 Community Response of Riparian Vegetation to Forest Management - Mike Newton, OSU Forest Science Dept.

2:45 QUESTIONS

3:05 Break

SESSION III:
RIPARIAN SILVICULTURE SYSTEMS
Moderator: Chal Landgren, OSU Forestry Extension

3:35 Alder: It's Growth, Management, and Conversion - Bill Emmingham, OSU Forest Science Dept.

3:55 Systems for Conifer Establishment in Riparian Areas - Cathie Bacon and Steve McConnell, COPE and Oregon State University

4:15 Long-Term Management of Riparian Vegetation for Multiple Objectives - Dave Hibbs, OSU Forest Science Dept.

4:35 Grazing and Oregon Riparian Zones - Wayne Ellmore, Bureau of Land Management

5:15 QUESTIONS

5:25 Close

8:00 NO-HOST SOCIAL AND POSTER SESSION

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Wednesday, December 13

SESSION IV:
IMPLEMENTATION AND EFFECTIVENESS OF BUFFER STRIPS
Moderator: Paul Adams, OSU Forest Engineering Dept.

8:15 Current Riparian Management Policies and Monitoring in the Pacific Northwest - David Morman, Oregon Dept. of Forestry

8:45 Buffer Strips - A Logging Engineering Viewpoint - Jim Neuman, Weyerhaeuser Co.

9:05 Buffer Strip Blowdown - Hank Froehlich, OSU Forest Engineering Dept.

9:30 Break

10:05 Survey of Existing Buffer Strips - Chris Roach, Siuslaw National Forest

10:25 Modeling Large Woody Debris Inputs from Riparian Management Areas - John VanSickle, OSU Fish & Wildlife Dept.

10:50 Buffer Strips and Stream Rehabilitation: A Fish Eye View - Bob House, Bureau of Land Management

:15 QUESTIONS

11:50 Group Lunch

1:00 Oregon's Current Forest Practices Rules: An Oregon Department of Forestry Perspective - Mike Schnee, Oregon Dept. of Forestry

1:25 Oregon's New Forest Practices Rules: An Oregon Department of Fish and Wildlife Perspective - Dan Carleson, Oregon Dept. of Fish and Wildlife

1:50 Break

2:20 PANEL DISCUSSION: Riparian Area Management - Past, Present, & Future
Moderator: Bob Beschta, OSU Forest Engineering Dept.
Panel Members: Al Abee, Bureau of Land Management
Ray Craig, Oregon Dept. Forestry
Dave Garber, Siuslaw National Forest
Paul Ketchum, 1000 Friends of Oregon
Dan Carleson, Oregon Dept. of Fish & Wildlife
Ken Munson, International Paper
Bruce Sutherland, Dept. of Environmental Quality

3:45 Workshop Summary - Bill Atkinson, Head, OSU Forest Engineering Dept.

:05 Closing Comments - Cathie Bacon, COPE and OSU

SESSION I

MANAGING RIPARIAN AREAS FOR FISH AND WILDLIFE HABITAT AND WATER QUALITY

MODERATOR: TIM BOZORTH, BUREAU OF LAND MANAGEMENT, ROSEBURG

THE EFFECTS OF RIPARIAN VEGETATION ON CHANNEL MORPHOLOGY, SEDIMENT, AND TEMPERATURE IN STREAMS

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Vegetation along streams functions in a variety of ways. The quantity and quality of energy inputs, coarse woody debris inputs, nutrient regulation, algal and macrophytic production, structure and function of biotic communities, and channel morphology are largely controlled by streamside vegetation. Streamside vegetation allows stream ecosystems to function in ways that structural additions alone to channels cannot replicate.

The geomorphic features of stream and river channels change in a downstream direction (i.e., with increasing stream order). Streams in headwater reaches are characterized by V-shaped valleys, relatively steep gradients, coarse bed sediments, and little floodplain development. Bedrock channels may be common. Downstream reaches have lower gradients, finer sediments and broader alluvial floodplains. As a result, the function and type of stream biota respond to the changing downstream influence of vegetation and the changing physical characteristics of a stream system.

Channel Roughness

Energy from water moving down a channel can be used to do work (e.g., transport sediment), but the vast majority is utilized to overcome frictional resistance along the bed and banks and is eventually dissipated as heat. The relative effectiveness of the water/channel interface to influence the dissipation of potential energy is indexed by its hydraulic "roughness".

The channel roughness concept does not focus on specific habitat units, such as individual pools or riffles. Instead, channel roughness indexes the overall hydraulic character of a stream reach and is determined by the summation of all the various channel and vegetation features that provide resistance to flow. The concept of channel roughness provides a useful means of integrating the effect of diverse conditions and features encountered in stream and river systems.

Vegetation affects channel roughness by influencing the relative surface irregularity of channels, variations in channel shape and size, the degree of meandering, and the occurrence of obstructions (e.g., large woody debris). The effectiveness of bank vegetation to influence overall channel resistance is important over a range of flows, but becomes critical at high flows, when flood waters are at or above bankfull stage, and when bank erosion or deposition

are most likely. Thus, direct and indirect effects of streamside vegetation make it an important factor influencing the hydraulic roughness of many streams and rivers. It has major short- and long-term consequences to channel characteristics and morphology, streambank and channel stability, ecosystem functioning, and the biological productivity of natural and man-made channels.

The natural occurrence of large woody debris from streamside forests also affects channel structure and roughness. For example, in alluvial stream systems, the turbulence and scouring action of the stream at high flow is common near fallen trees, root wads, and accumulations of coarse woody debris in a channel. These coarse woody debris obstructions locally create pools of various sizes and morphology. Even in high-gradient streams, channel diversity can be enhanced by the sediment captured behind debris dams.

Studies indicate that the removal of streamside vegetation can greatly decrease the hydraulic roughness of a stream, hence increasing the erosive capability of the stream. Even though short-term changes in channel resistance can often be dramatic following complete removal of streamside vegetation and large woody debris, there is a lack of studies that have followed long-term changes in channel roughness associated with more pervasive vegetation management practices.

Floodplains represent special landforms associated with riverine landscapes where streamside vegetation has naturally assisted the long-term deposition of fine sediments. Where floodplain forests have been converted to agricultural and other uses, the hydraulic roughness is greatly reduced. Thus, the removal of riparian forests and associated understory vegetation can greatly influence channel and floodplain stability, with subsequent effects to onsite erosion, sediment transport, and aquatic habitat. Similarly, reforestation of formerly harvested riparian areas that are prone to flooding will increase the hydraulic resistance at high flows and help reestablish root systems that can maintain streambank integrity.

Channels that are hydraulically "rough" are most likely to be channels characterized by a high degree of trapping and retention of both sediment and organic matter during high flow. This organic matter is a major food source for aquatic organisms. The importance of "inchannel" trapping and retention mechanisms tends to decrease with increasing stream size. In small mountain streams, coarse bedload sediments and coarse woody debris are commonly stored within the channel. For larger streams and rivers, floodplains, secondary channels and backwater areas become major locations for the trapping and retention of organic matter and fine sediment during high flows.

Streambank Integrity/Stability

Vegetation is a key ingredient to the protection of banks and riparian soils from the erosive forces of moving water. Above-ground plant parts (stems of trees, shrubs, grasses and forbs) tend to dampen turbulence and slow velocities during overbank flows. Below-ground, root systems and organic matter help bind soil particles of previously deposited sediments. Streambanks that are held together by roots offer far greater resistance to lateral erosion than unvegetated banks. Thus streambank sediments and soils are often able to resist the erosive forces of water during high flow. Particularly at the outside of a bend, woody vegetation is capable of greatly reducing the rate of bank erosion that a particular stream or river may experience. Even where woody root systems in a streambank are exposed by water, they can continue to provide mechanical protection from turbulent water and floating debris.

Tree roots in particular, because of the longevity of many tree species, provide long-term stability at a given location along a channel. Thus, for many forest streams, the effects of vegetation can have a dominant influence on channel morphology and pattern. Over long periods of time, the regeneration, growth, and succession of forest vegetation and associated species provides the mechanism by which riparian plant communities can continually respond to natural changes in streamflow, sediment loads, and local shifts in channel morphology.

Sediment Transport

The downstream movement of water in channels provides the mechanism via which dissolved nutrients, organic matter, suspended sediment and bedload sediment are transported through a stream system. The movement of sediment through stream reaches of varying gradient, size, and morphology is difficult to simply characterize or predict. However, vegetation again plays a direct and indirect role in the movement of sediments, including: (1) resisting fluvial erosion of alluvial or colluvial deposits, (2) slowing the rate of bedload transport because of highly variable channel morphology and relatively high hydraulic roughness, and (3) causing local deposition of sediments. In many instances, riparian vegetation may exist entirely on previously laid-down alluvial sediments.

Because stream banks along forest streams may be comprised of sediments that may have been deposited over decades, or even centuries, an important role of riparian vegetation is to prevent erosion of these materials. Where riparian vegetation is dense, continued deposition and "bank building" can occur over a wide range of flow events.

The highly variable channel morphology characteristic of many forest streams, particularly those with high

loadings of coarse woody debris, indicates that channel adjustments, indicated by local scour and fill, is a common occurrence during high flows. This is particularly true of the coarser sediments that normally comprise the streambed. However, few field studies have been conducted which indicate the effect of streamside vegetation on bedload transport. Never-the-less, debris accumulations, coarse woody debris, and the roots of streamside vegetation (which help control local channel morphology) are undoubtedly linked to bedload transport rates in many forest streams.

For streams with significant overbank flows, particularly those with defined floodplains, vegetation reduces the velocity of overbank flows and decreases erosion potential. Grasses, forbs, brush and other low-growing plant species under the forest canopy, in addition to the trees, are particularly effective at providing flow resistance and protection to soils during high flows.

The interconnection between soil-hydrology-vegetation is increasingly recognized in the jurisdictional delineation of wetlands and riparian areas, but we have not yet made the conceptual leap of applying this perspective to the management of riparian areas. Until we better understand how spatially variable soils and temporarily variable hydrology interact to affect species regeneration, growth, and longevity, we will be ill equipped to make enlightened management decisions. The importance of vegetation for providing bank integrity yet allowing for local scour and fill of sediments, to store and process nutrients, and to diffuse and dissipate stream energy along the channel is becoming increasingly recognized. Where additional structural diversity of channels is desired, ecosystem processes and vegetation succession that will ultimately provide for and sustain such diversity need to be identified and promoted.

Coarse Woody Debris

Over the last several decades, numerous investigations have documented the importance of woody debris for instream structure and fish habitat. Woody debris and snags in streams provide a number of functions of biological importance: (1) creates and maintains pools, (2) causes local reductions in stream velocities that serve as foraging sites for fish feeding on drifting food items, (3) forms eddies where food organisms are concentrated, (4) supplies protection from predators, (5) provides shelter during winter high flows, and (6) traps and stores organic inputs from streamside forest enabling them to be biologically processed.

The relative loadings and principal roles of coarse woody debris change throughout the river system. In steep headwater streams where logs can easily span a channel, debris that becomes incorporated into a channel helps create a stepped longitudinal profile. This stepped profile, in

turn, affects the storage and release of sediment and facilitates the biological processing of other organic inputs from the surrounding forest. As stream size continues to increase, debris accumulations and debris jams become more common as the stream is more likely to mobilize and transport some of the coarse woody debris inputs. Under these circumstances, relatively large pieces of coarse woody debris, either individually or in combination, provide important roughness elements upon which other pieces accumulate. In all but the smallest streams, there occurs some degree of clumping, although the size and spacing of debris accumulations generally increase in size in a downstream direction. When the stream channel becomes too wide to be spanned by large logs, the deposition of debris occurs along channel margins or secondary channels where it forms productive fish habitat.

Where logging has removed forest vegetation along a stream, the residual debris may continue to function for a century or more as it slowly decays and is broken down. However, a second-growth forest is unlikely to contribute much coniferous woody debris for at least a century or more following streamside harvesting. In the case of intensive management of riparian forests solely for timber production, where mortality is reduced by precommercial and commercial thinnings or where the rotation age is short, it would appear unlikely that streamside forests will contribute significant amounts of wood to a stream.

Forest Cover and Stream Temperature

The thermal regime of streams draining forested watersheds varies seasonally throughout the Pacific Northwest. However, most stream temperature concerns in forest ecosystems have focused on summertime increases associated with forest harvesting and the removal of streamside vegetation which provides shade to the stream. Research results have consistently shown that summertime temperatures of small streams can be increased when streamside forest cover is removed. In general, the magnitude of temperature increase varies inversely with size of stream (i.e., stream discharge), hence larger streams are less affected by the removal of streamside canopy than smaller streams. The amount of temperature increase is directly associated with the amount of stream exposure to incoming solar radiation, thus as streamside canopy is increasingly removed, the greater is the exposure of a stream to incoming solar radiation and the greater the increase in stream temperature.

Many variables affect the relative amount of shade produced by streamside vegetation (i.e., tree species, age, crown characteristics, canopy cover, distance from stream, etc.). However, measurements of angular canopy density along forested streams in western Oregon indicates that bufferstrip width is an important factor affecting the

amount of shading from trees left along a stream. For example, in the Oregon Coast Range, bufferstrip widths of approximately 75 feet, or more, appear to provide approximately the same level of shade protection as an old-growth forest. However, in the Cascades bufferstrip widths of 100 feet or more may be needed if the objective is to maintain stream shading at a level comparable to that of an old-growth forest. Where streamside vegetation along small streams has been removed by harvesting and burning, the return of shading to levels comparable to old-growth conditions requires about a decade in the Oregon Coast Range as regrowth of forest trees and brush occurs; in the Cascades approximately two decades of regrowth may be needed.

Water temperature responses to the removal of riparian vegetation have been widely documented in the scientific literature and are widely recognized by practicing foresters and fisheries biologists alike. Less clear are the impacts of these thermal changes to fish and other aquatic organisms. Several reasons exist why logging-related temperature increases do not appear to have had wide ranging deleterious effects on fish populations: (1) the wide thermal tolerances of many resident salmonid species, (2) the natural diurnal cycling of stream temperatures which limits exposure to maximum temperatures, (3) the occurrence of localized cool-water sources from subsurface water or tributary inflow which fish seem to be able to locate and utilize, and (4) the ability of fish to migrate to other locations or to temporarily curtail activities when temperatures become stressful. In many instances, it appears that fish may be able to tolerate increases in stream temperature without major adverse impacts on growth or mortality. Even so, increased summertime stream temperatures remain a concern to fisheries managers. Temperature is clearly an important component of the habitat of many stream organisms, including fish, and most organisms respond to changes in stream temperatures caused by the removal of riparian vegetation. But, because temperature is only one of several closely interconnected factors that are affected simultaneously by streamside harvesting, it may be of no surprise that a clear understanding of temperature effects has not yet emerged.

Summary

An important characteristic of diverse streamside vegetation is the continuity that it lends to stream ecosystems. By stabilizing streambanks, intercepting eroding sediment from the adjacent land surface, providing a long-term source of large woody debris, and moderating water temperatures, streamside vegetation is largely responsible for maintaining the physical integrity of stream and river channels over a wide range of environmental conditions. It is also interesting to note that where forest trees are left

for shade protection they typically provide for many of the other functions of a riparian system.

The multitude of channel and vegetation combinations found along forest streams of the Pacific Northwest have important implications regarding the role of this vegetation in charting the character of streams and rivers of the region. Because streams, riparian vegetation and underlying are so interlinked, it is only appropriate that we pay special attention to the management of riparian areas. They cannot simply be managed like adjacent uplands because riparian vegetation typically has different site and environmental requirements for regeneration and succession. Optimal riparian conditions for water quality and fish habitat may best be attained by helping vegetation along entire reaches to function in a productive and self-sustaining capacity. Because riparian areas are well connected to the fluvial system, management of riparian areas should be undertaken in ways that compliment their natural dynamics and functions. Developing and undertaking such management practices will provide numerous challenges to forest managers.

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The Effects of Riparian Vegetation on Light, Nutrient Cycling and Food Production in Streams

Stan Gregory, Department of Fisheries and Wildlife, Oregon State University.

Streamside forests profoundly influence the physical environment and ecological processes of stream ecosystems. Alteration of the forest canopy changes the inputs of solar radiation, affecting both light energy and temperature. The change in light is greatest in headwater streams, decreasing as the canopy opening widens. Greater inputs of light enhance aquatic plant production. This stimulation of plant production rarely results in major increases in the biomass of plants because aquatic herbivores rapidly consume most of the additional production. Instead, algal food is more available for higher trophic levels. Increased abundance of certain aquatic insects, particularly mayflies and midges, are commonly noted in harvested reaches.

Where geomorphic stability and habitat complexity are maintained, increase production of aquatic insects may cause increases in fish production. Most of this production occurs during the summer low flow period. In cases where fish habitat is degraded, increased fish production during summer may not occur or will be lost during winter floods. Because of the complex interactions between food resources and physical habitat, responses of stream salmonids and other fish species to timber harvest vary greatly. Many studies have demonstrated declines in fish abundance after logging, and other studies have shown increases in fish abundance.

Streamside vegetation affects nutrient loss from basins both directly through root uptake and indirectly through influences on aquatic plants and inputs of woody debris and leaves. Subsurface flow of nutrients passes through the rooting zone of riparian vegetation as it emerges into surface waters. Streamside vegetation can remove more than 75% of the nitrogen moving from upslope into stream channels. In addition, nutrients are rapidly transformed by the enhanced microbial activity in the moist, organic rich streamside environment. Stream communities rapidly remove nutrients from streamwater. More than 90% of added nitrogen can be removed within 300 m in streams with complex floodplains. Canyon reaches in the same streams removed less than 25% of added nitrogen. In a first-order watershed in the Cascade Mountains, more than 50% of the nitrogen entering the stream in groundwater was removed before leaving the watershed. Streams and floodplain have a high potential to retain both particulate and dissolved nutrients.

Silvicultural operations can be designed to: 1) promote rapid development of nutrient filtering capability, 2) enhance regeneration of riparian species, 3) encourage spatial complexity, 4) accelerate inputs of woody debris, and 5) maintain structure and functions of mature riparian forests. Silvicultural operations offer many opportunities to rehabilitate or maintain riparian forests. For example, thinning operations can be coordinated with rehabilitation projects to reestablish loading of woody debris. Some activities such as reservoir cleaning or piling unmerchantable material may provide inexpernsive material for debris rehabilitation projects.

Unfortunately, we have limited knowledge of the dynamics of riparian forests. Riparian forests are currently managed as upland forests would be managed, even though community composition, plant distribution, regeneration, and tree growth and mortality may differ greatly. Riparian silviculture is an area of land management where major advancements are badly needed and well within our reach.

LARGE WOODY DEBRIS AND FISH

Tom McMahon, COPE and OSU, Marine Science Center, Newport

Gordon Reeves, Pacific Northwest Research Station, Corvallis

Ecologists often make reference to keystone species- i.e., those species that have a profound influence on the abundance and distribution of other members of a community. Through its influence on channel shape, sediment and organic matter retention, pool formation, bank stability, current velocities, and cover availability, large woody debris might be thought of as a 'keystone' habitat feature that influences the abundance and distribution of salmonid fishes in many and complex ways. Similar to keystone species, the important influence of wood on fish habitat quality and quantity is best illustrated when debris has been removed from a system. With the loss of debris, stream channels become simpler, less stable, and lose much of the habitat complexity necessary for providing the diversity of substrates, current velocities, and cover used as spawning, feeding, and resting sites by salmonids.

As information and awareness of the key role that debris plays as salmonid habitat has increased over the past decade, state and federal agencies now require the protection of instream debris and the retention of standing conifers along fish-bearing streams following harvest. Management of riparian areas to provide the appropriate quantity (number of pieces) and 'quality' (tree species, sizes, and configurations) of large woody debris requires knowledge of a) the relationship between debris level and associated abundance, distribution, and diversity of fish populations, and b) how the quantity and quality of debris (and hence fish habitat) varies under different management practices.

Debris and fish relationships. Large woody debris can affect the habitat quantity and quality for all freshwater life stages of salmon and trout in streams, from headwaters to the estuary. While too much wood can obviously block upstream migration of adults returning to spawn, large woody debris also creates deep pools of cool water and provides cover; this function is particularly important for summer run chinook and steelhead holding in lower river reaches during summer low flows and high temperatures. Debris also traps salmon carcasses, a nutrient source for aquatic and terrestrial animals in streams. For the egg stage, debris traps spawning gravel and minimizes scour during winter freshets. Loss of debris can release large quantities of fine sediment which can then be transported downstream and deposited on spawning beds in lower reaches and estuaries. Juvenile salmon and trout are most abundant in various types of pools, which often are formed by large wood. Previous studies have generally found a strong positive relationship between amounts of debris and juvenile salmonid abundance. In particular, salmonids are closely associated with debris during winter. In coastal systems, winter is a time of high flows and lower temperatures. The structural complexity or configuration of debris has been shown to be an important habitat feature affecting habitat use and overwinter survival. Debris combining low velocity refuge, shade, and three-dimensional complexity is needed to provide adequate shelter during frequent winter freshets. Recent evidence further suggests that debris accumulations provide important habitat in streams and estuaries for coho salmon during their physiological transformation and migration to the sea as smolts. Debris also appears to affect fish community

structure, with fewer age classes and fewer species ocurring in streams lacking wood.

Debris characteristics in forested streams. Streams draining mature and old growth forests contain large quantities of large woody debris (>10 cm in diameter and >3 m in length). Past disturbances, namely, splash damming, overzealous stream cleaning, agricultural conversion, fire, streamside logging, and snagging have led to declines in large debris in Northwest streams. Estimates are that 50-85% of the 17,000 miles in western Oregon are debris-poor. Following disturbance, streamside forests often change from multilayered, more open canopies, with mixed species of vegetation, to dense, single story stands of alder with closed canopies. In streams bordered by second growth stands, debris abundance is about 50-90% lower than in mature and old growth forests; also, the remaining debris is generally smaller and less stable. However, pre-disturbance debris can continue to influence pool formation and fish habitat for many decades. But, the flip side to the longevity of large debris in streams, is that it also requires many decades to replenish. Surveys of streams in western Washington by Grette and western Oregon by Heimann revealed that second growth riparian forests do not begin to produce the tree sizes (> 25-35 cm in diameter) necessary to form stable debris for at least 50 years, and debris levels of mature forests may not be return for perhaps 120 years or more after logging or other disturbance. Alder debris inputs can be quite substantial in younger stands, but it has a relatively short residence period in most streams.

Debris management. Strips of conifers are now commonly left along streams following harvest to ensure protection of existing debris and provide a continued supply of future debris. Riparian management guidelines for leave strips range from no harvest, to double rotation, to selective harvesting (see Bisson et al. for discussion). While some studies indicate leave strips effectively maintain fish habitat and populations over the short term, conifer leave strips have not been in place long enough to know if they will be sufficient to provide the quantity and quality of debris necessary to maintain productive fish habitat over the long term. Questions about buffer strip width and number of trees that need to be left are difficult to answer. Current monitoring studies will help, but the long time intervals required to study the effectiveness of different riparian management protocols for large woody debris necessitate a longer view. Simulation models (re: VanSickle presentation) offer an opportunity to test debris inputs over time over a range of different riparian management scenarios.

To date, target levels for numbers of trees to be left along streams for a future source of woody debris have been derived from measurements of debris amounts in old growth streams. For example, a correlation between debris level and riparian stand density derived from a survey of 60 streams in eastern Washington was used to evaluate the adequacy of proposed regulations at providing debris to streams. At present, critical experiments testing the relationship between debris level and smolt production have not been done. Thus, it is difficult to precisely measure trade-offs of various debris management practices in terms of fish production. Nevertheless, as Bisson et al. (1987) noted: "... salmonid populations have evolved in debris-rich environments ... and have developed adaptations that enable them to maximize production in hydraulically complex channels where debris is abundant."

What about desired sizes and species of debris? Stability and longevity of debris are considered important factors for maintaining quality habitat over time.

Surveys of debris characteristics in western Washington streams by Bilby and Ward revealed that diameter and size of stable debris increased with stream size. These values suggest that small streams < 5m wide require trees of about 30-35 cm (12-14 inches) to form stable fish habitat; medium-sized streams (~10 m wide) require trees about 45cm or 18 inches in diameter. A current COPE study is experimentally placing debris of different sizes and orientation in small streams to more closely examine the relationship between debris size and orientation to debris stability, pool configuration, sediment storage, and fish habitat quantity and quality.

Current information suggests that, in terms of longevity, western redcedar (= spruce?) >> Douglas-fir western hemlock >> red alder. Retention times of large cedar may be a century or more; for alder, perhaps 10-30 years. In a study currently underway in Washington, Bob Bilby and Jeff Cederholm are measuring decay rates and strength of various species of trees in water over time to quantify expected longevity of debris.

What about debris management for fish habitat in second growth riparian stands? Since many stream miles currently exist in a range of declining and low debris levels and heavy canopy cover, there appears to be the opportunity to manipulate debris and canopy to enhance fish production. Additions of large woody debris are now commonly and widely used as a means to increase fish production. However, such additions often entail the use of heavy equipment to move the wood, so in addition to the cost of doing this, access also limits the feasibility of adding wood to streams to about 5-10% of the total stream miles.

An additional approach we are exploring at this workshop is the idea of actively manipulating riparian vegetation to speed up the successional process and narrow the time frame for future delivery of large dead trees to the stream. Managing riparian vegetation is managing fish habitat, and silviculturists could aid in maintaining and improving fish habitat in other ways. For example, management of food species for beaver, management of 'live' alder as woody debris in streams, and management of fast-growing trees for bank stability and fish habitat along streams bordering agricultural lands (see COPE study on planting red alder and hybrid poplar).

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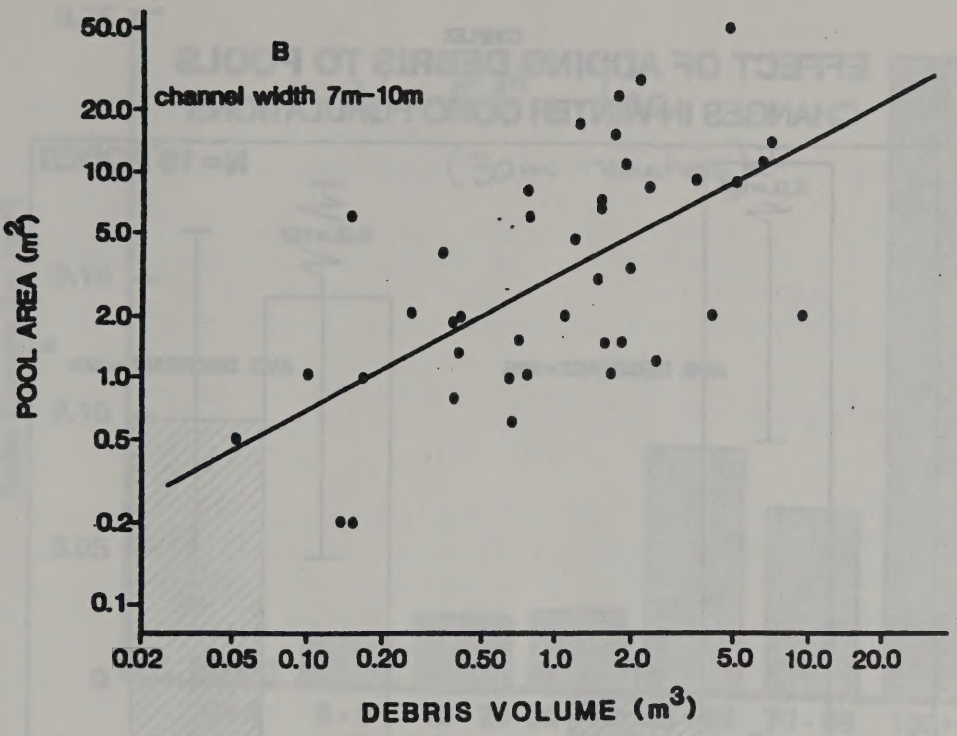
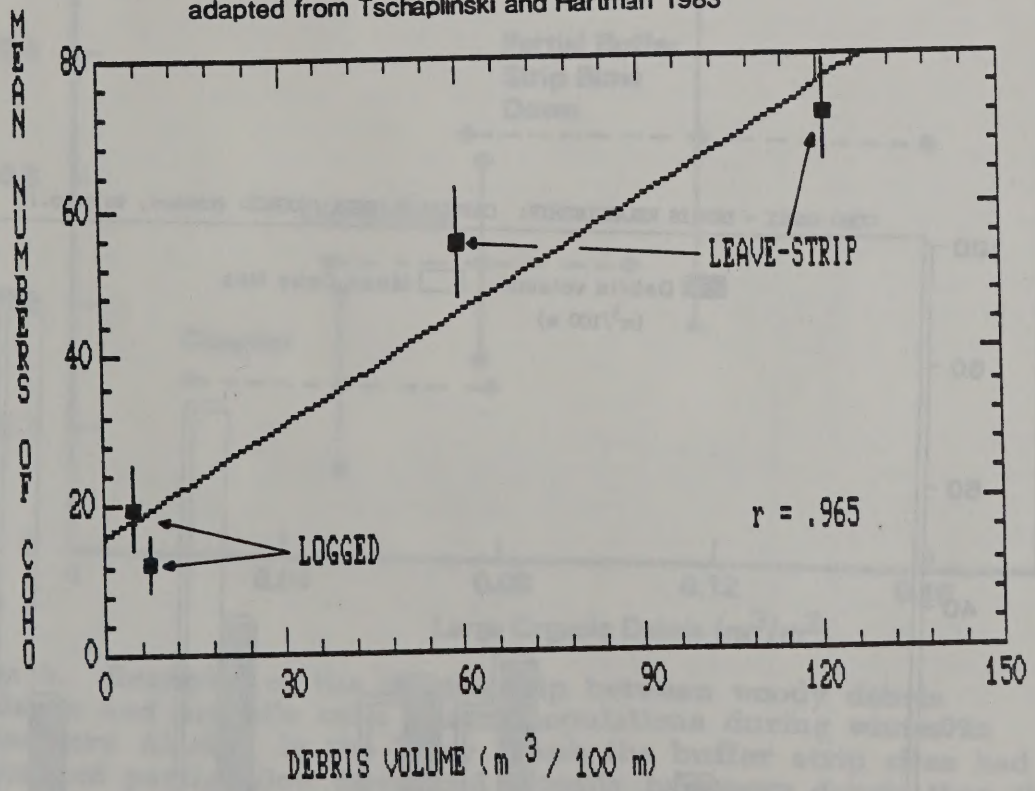


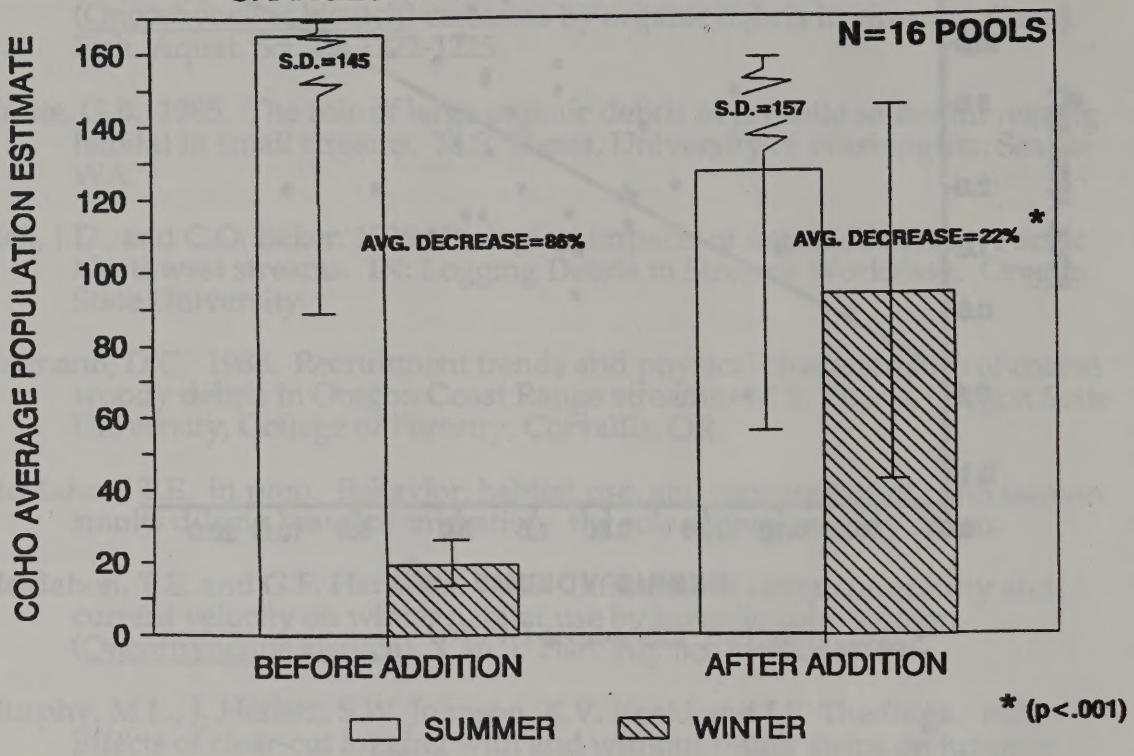
Source: Bilby and Ward (1989)

adapted from Tschaplinski and Hartman 1983

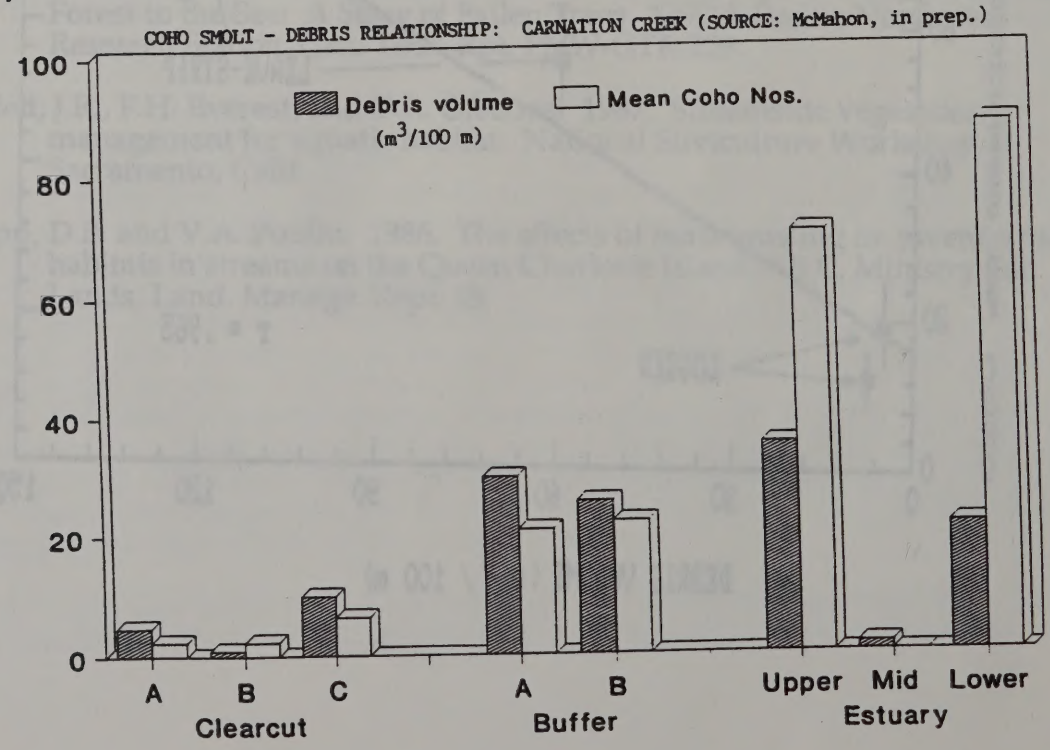


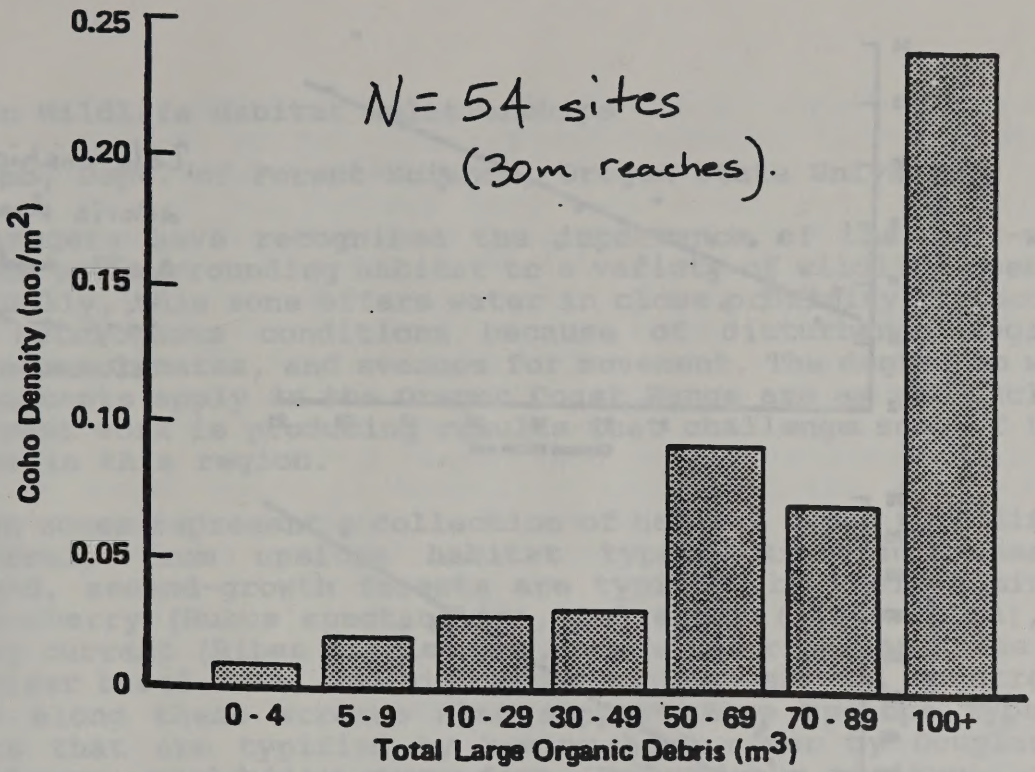
EFFECT OF ADDING COMPLEX DEBRIS TO POOLS

CHANGES IN WINTER COHO POPULATIONS



Source: S. Johnson, ODFW, Newport





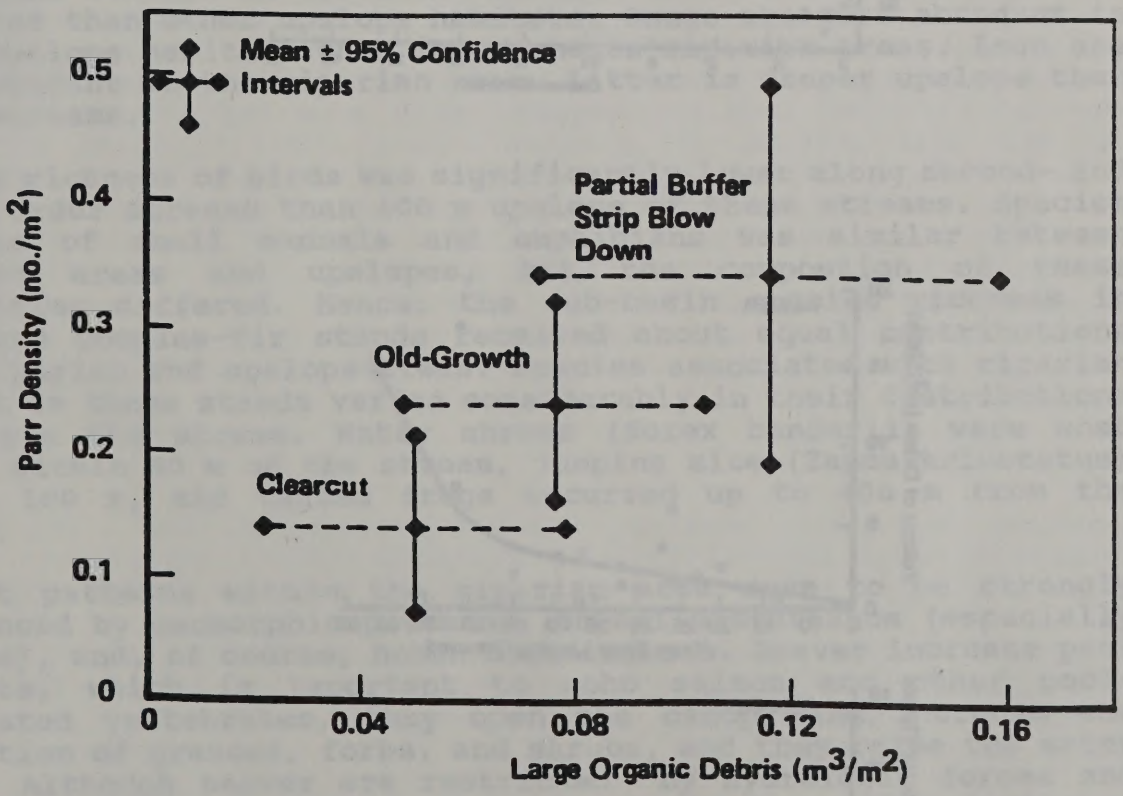
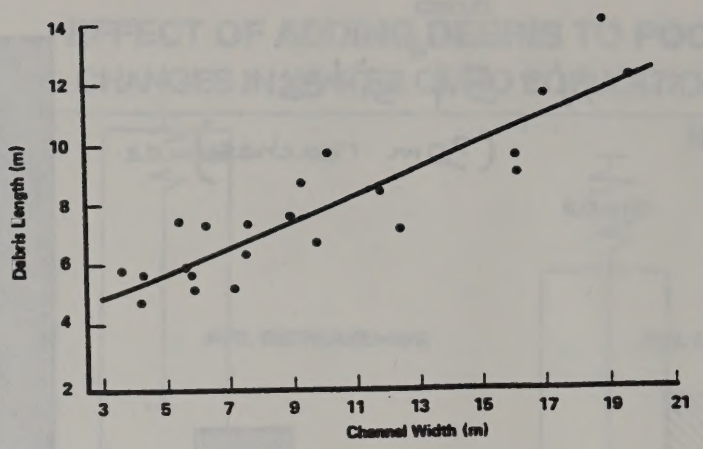
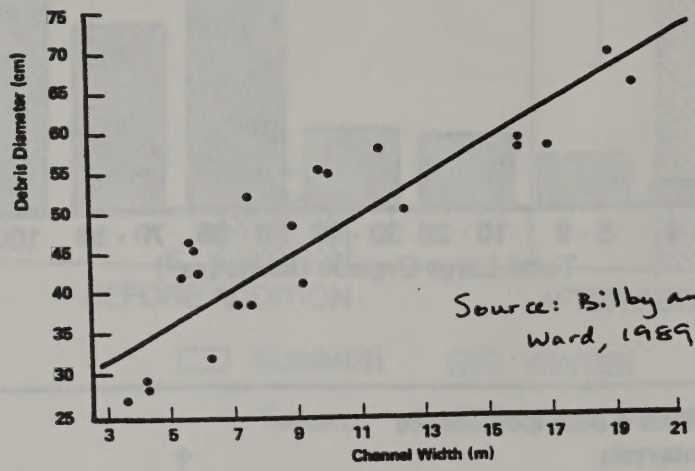


Figure 6. Examples of the relationship between woody debris abundance and juvenile coho salmon populations during winter in southeastern Alaska. In the lower graph the buffer strip sites had experienced partial blow down and actually had more debris than the old-growth sites (from Murphy et al. 1985).

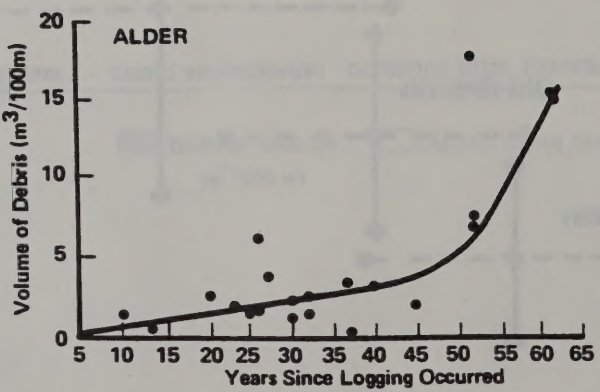
Source: Bisson et al. 1987.



Relationship between debris diameter and length and stream size in old-growth streams.



Source: Bilby and Ward, 1989



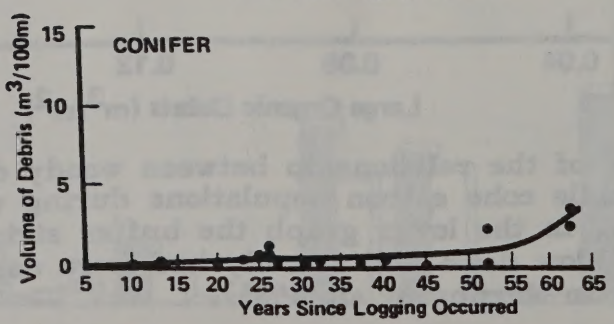


Figure 9. Inputs of red alder and conifer debris to small streams in second-growth forests in western Washington (from Grette 1985).

Riparian Wildlife Habitat Relationships

W. McComb, Dept. of Forest Science, Oregon State Univeristy

Land managers have recognized the importance of the land-water interface and surrounding habitat to a variety of wildlife species. Conceptually, this zone offers water in close proximity to food and cover, heterogeous conditions because of disturbance regimes, stable microclimates, and avenues for movement. The degree to which these concepts apply in the Oregon Coast Range are as yet unclear, but current work is producing results that challenge some of these concepts in this region.

Riparian zones represent a collection of habitat types that differ, in general, from upslope habitat types. Riparian zones in unmanaged, second-growth forests are typified by their dominance in salmonberry (Rubus spectabilis), red alder (Alnus rubra), and stinking currant (Ribes bracteosum), hence the riparian zones have low conifer basal area, and high cover by tall shrubs. Constrained reaches along these streams also support more upslope types of habitats that are typified by having high cover by Douglas-fir (Pseudotsuga menziesii), sword-fern (Polystichum munitum), salal (Gaultheria shallon), and Oregon-grape (Berberis spp.). Upslope areas also contain intermittent streams that have a more riparian character than other upslope habitats. Snags are more abundant in these upslope habitats than in unmanaged riparian areas. Logs are more abundant in the riparian zone. Litter is deeper upslope than along streams.

Species richness of birds was significantly lower along second- and third- order streams than 400 m upslope of these streams. Species richness of small mammals and amphibians was similar between riparian areas and upslopes, but the compostion of these communities differed. Hence, the sub-basin species richness in unmanaged Douglas-fir stands received about equal contributions from riparian and upslope areas. Species associated with riparian habitat in these stands varied considerably in their distributions away from the stream. Water shrews (Sorex benderii) were most common within 50 m of the stream, jumping mice (Zapus trinotatus) within 100 m, and tailed frogs occurred up to 400 m from the stream.

Habitat patterns within the riparian area seem to be strongly influenced by geomorphic patterns, animal disturbance (especially beavers), and, of course, human disturbances. Beaver increase pool habitats, which is important to coho salmon and other pool-associated vertebrates, they open the canopy and increase the production of grasses, forbs, and shrubs, and they raise the water table. Although beaver are restricted by hydrologic forces and geomorphology in where they can build their dams, they influence habitat quality for many other species within a portions of the mid-basin.

Early seral stages in riparian zones created by previous timber harvest provided excellent habitat for jumping mice, but not for tailed frogs (Ascaphus truei). Mature and old-growth mixed conifer hardwood riparian zones were good habitat for tailed frogs and water shrews, but not for jumping mice. Although conifers may be desirable in riparian areas for some wildlife species, they do not seem to be desirable for all species. Mature red alder stands seem to support a rich amphibian and small mammal fauna, hence we should consider whether we want conifers present in all riparian areas. Many of the species occupying alder stands that are cut and burned prior to being converted to Douglas-fir seem to be able to survive the disturbance and move over these disturbed sites following burning, but based on data collected in other shrub and pole-dominated riparian areas, resultant changes in habitat seem to lead to reductions in the occurrence of some of these riparian associated species.

Although snags were not common in unmanaged riparian areas, managers may be inclined to suggest that riparian areas can provide adequate numbers of snags and logs for wildlife at the sub-basin level because these areas are being set aside. If riparian areas are expected to meet the needs of riparian associated species, mature forest associated species, and provide corridors, then careful consideration must be given to the placement and management of stands in riparian areas. From a wildlife habitat management standpoint, I do not think that we are in a position to begin active management to meet multiple wildlife species objectives through riparian zone management. Much more information is needed on the distribution of species along intra-riparian gradients relative to upslope stand conditions. If the land management goal is to sustain indigenous wildlife species within sub-basins, then, in my opinion, we should maintain our options by forgoing active riparian zone management (perhaps other than managing beaver populations) until additional information is available, and we should increase our options in upslope areas by providing habitat for species that are not likely to be influenced by riparian conditions.

Recommended Readings

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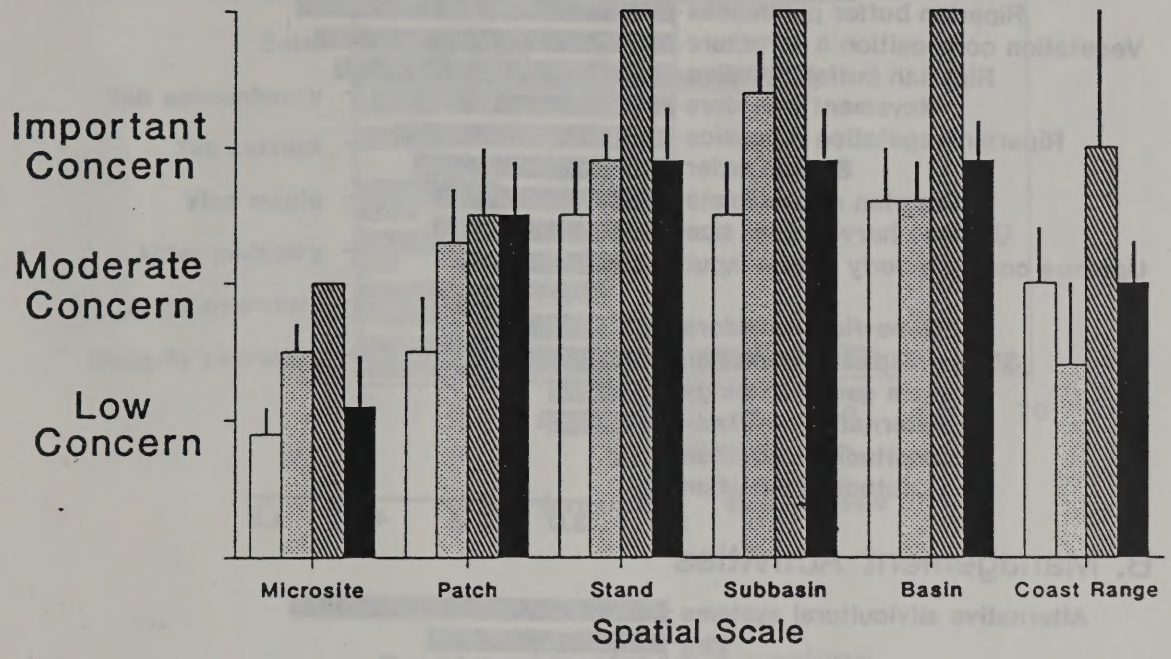
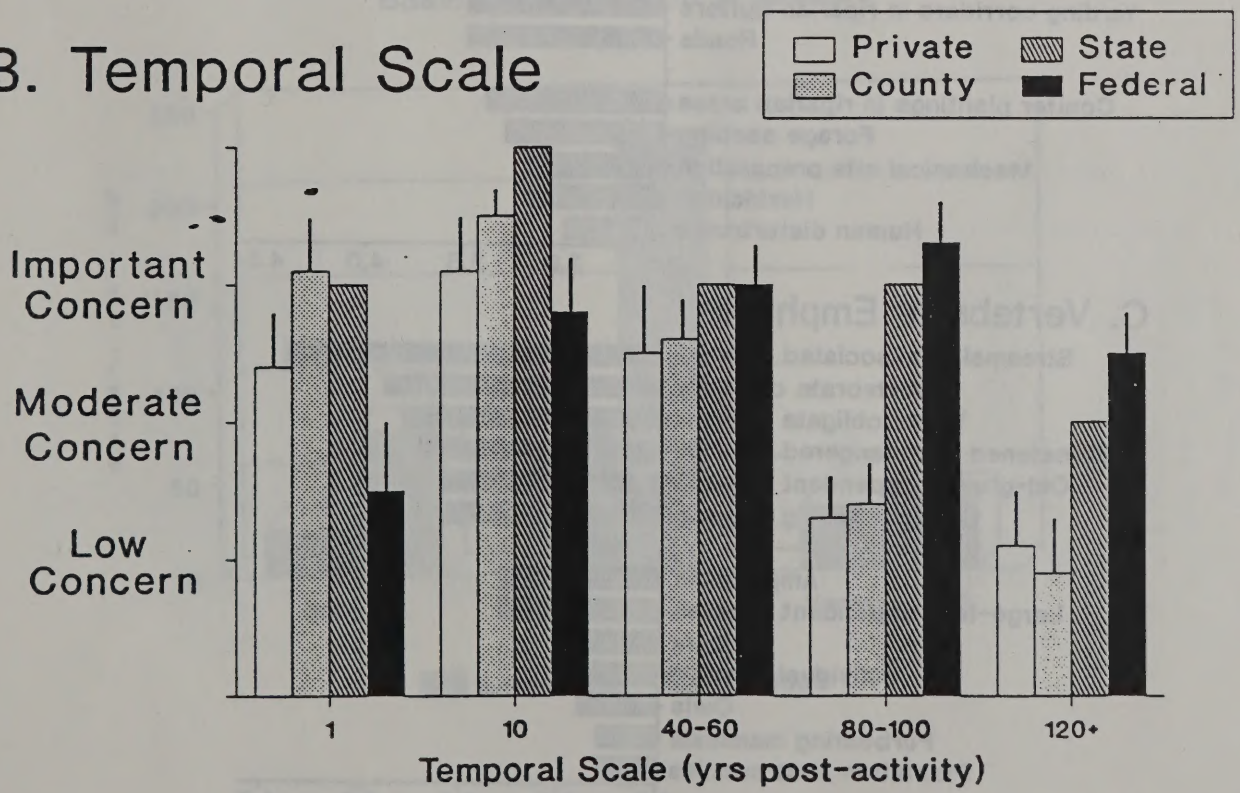
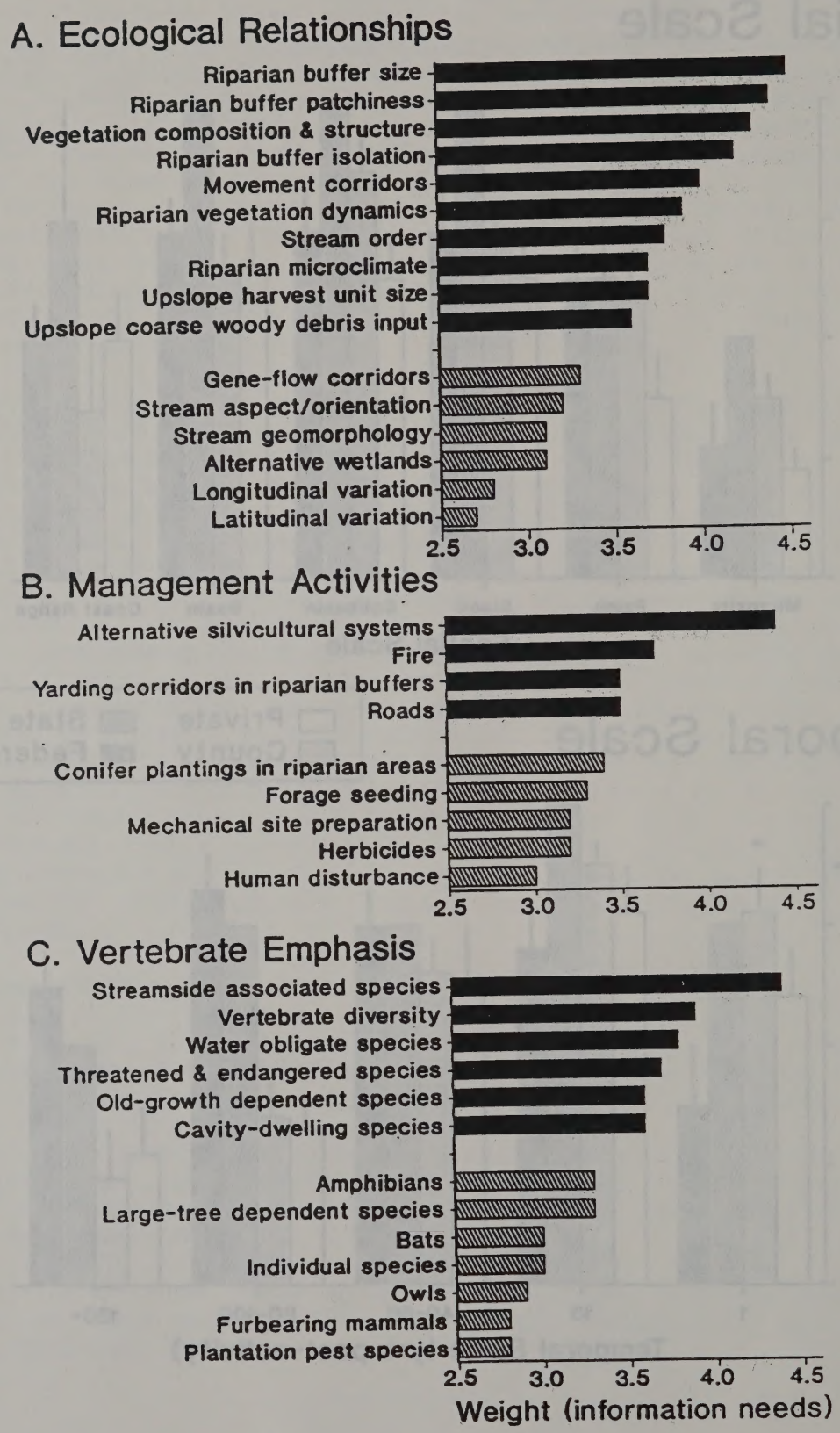
A. Spatial Scale

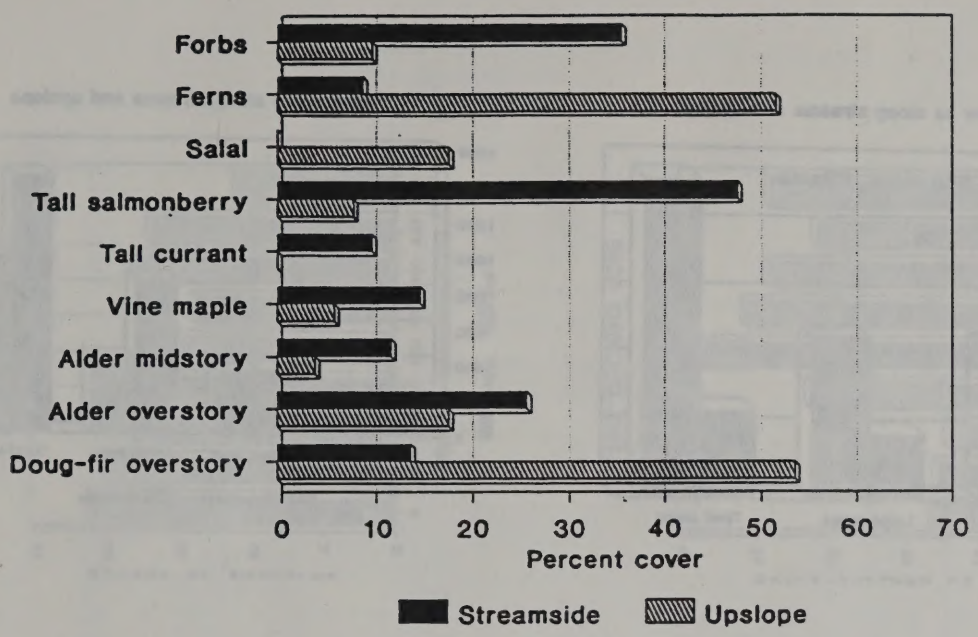


B. Temporal Scale

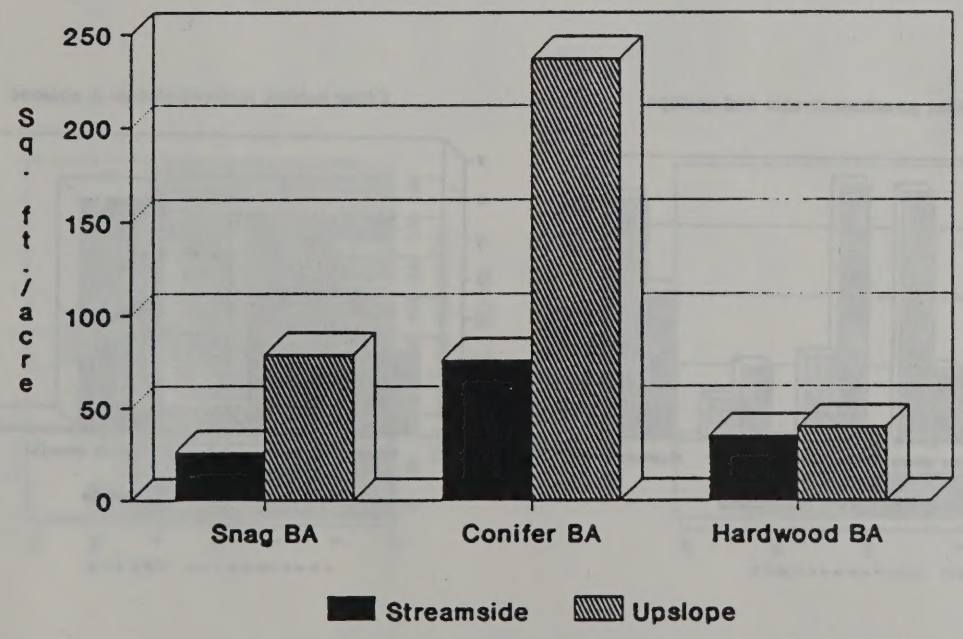



A. Ecological Relationships
Riparian buffer size
Riparian buffer patchiness
Vegetation composition & structure
Riparian buffer isolation
Movement corridors
Riparian vegetation dynamics
Stream order
Riparian microclimate
Upslope harvest unit size
Upslope coarse woody debris input
Gene-flow corridors
Stream aspect/orientation
Stream geomorphology
Alternative wetlands
Longitudinal variation
Latitudinal variation
2.5
3.0
3.5
4.0
4.5
B. Management Activities
Alternative silvicultural systems
Fire
Yarding corridors in riparian buffers
Roads
Conifer plantings in riparian areas
Forage seeding
Mechanical site preparation
Herbicides
Human disturbance
2.5
3.0
3.5
4.0
4.5
C. Vertebrate Emphasis
Streamside associated species
Vertebrate diversity
Water obligate species
Threatened & endangered species
Old-growth dependent species
Cavity-dwelling species
Amphibians
Large-tree dependent species
Bats
Individual species
Owls
Furbearing mammals
Plantation pest species
2.5
3.0
3.5
4.0
4.5
Weight (information needs)

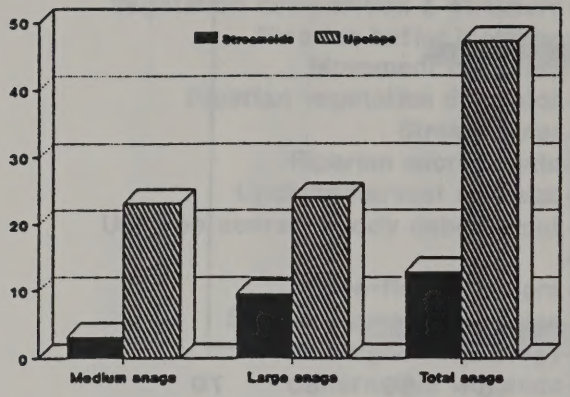
Vegetation composition:stream & upslope



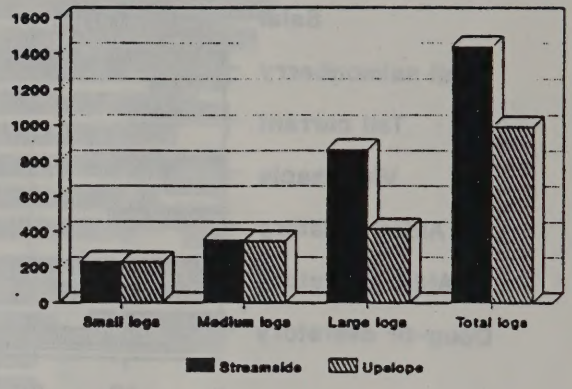
Basal areas: stream & upslope



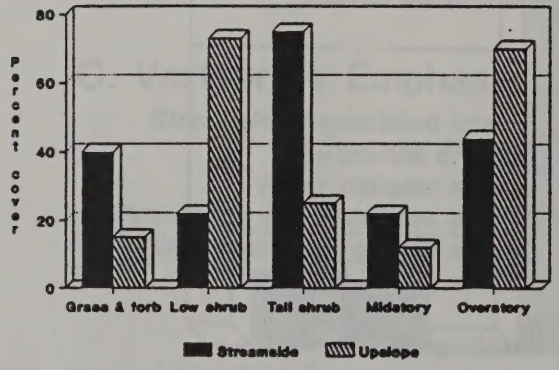
Snags per ha along streams and upslope



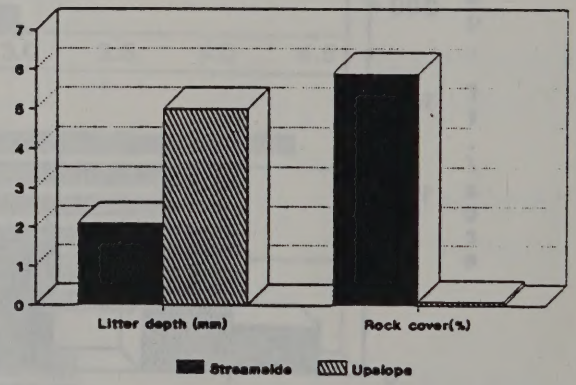
Logs(m/ha) along streams and upslope



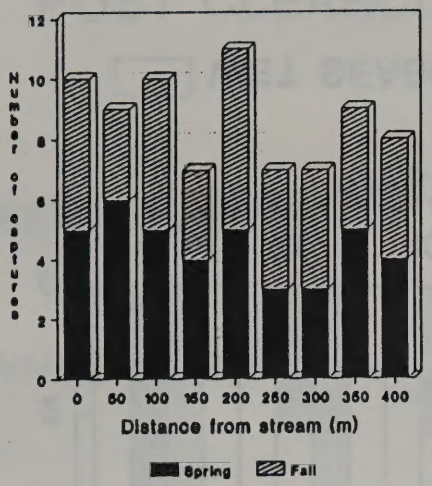
Vegetation structure:stream and upslope



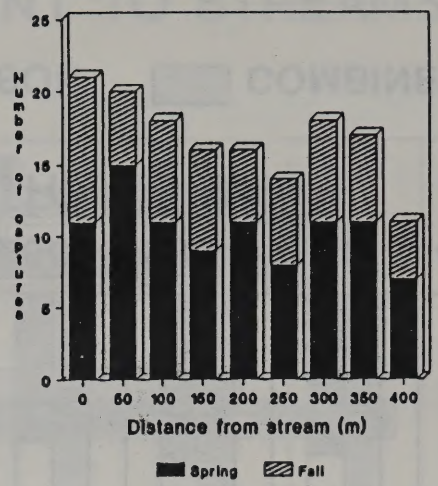
Other habitat features:stream & upslope



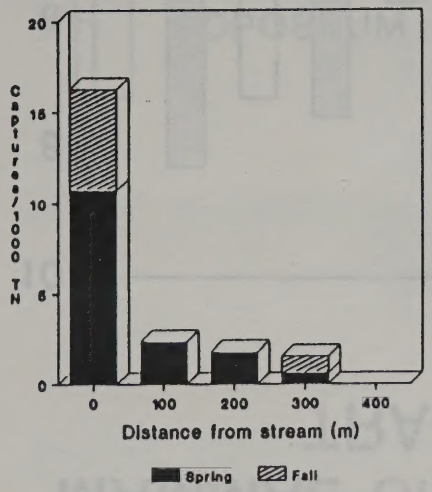
Amphibian species



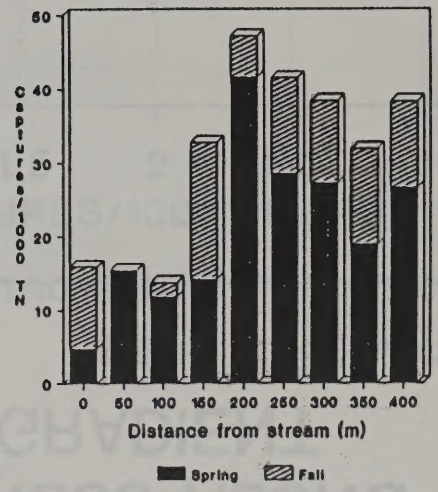
Mammal species



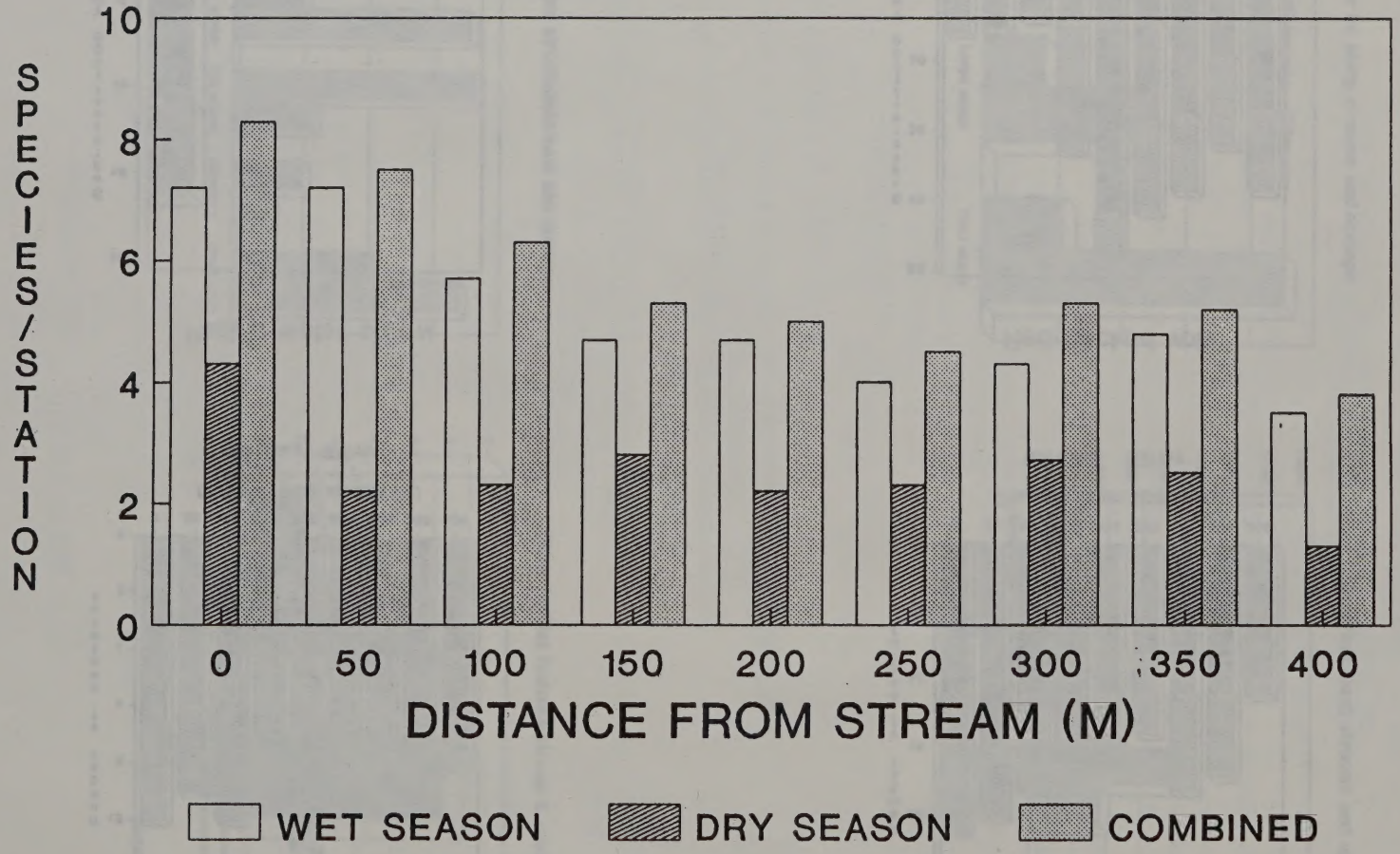
Pacific water shrew



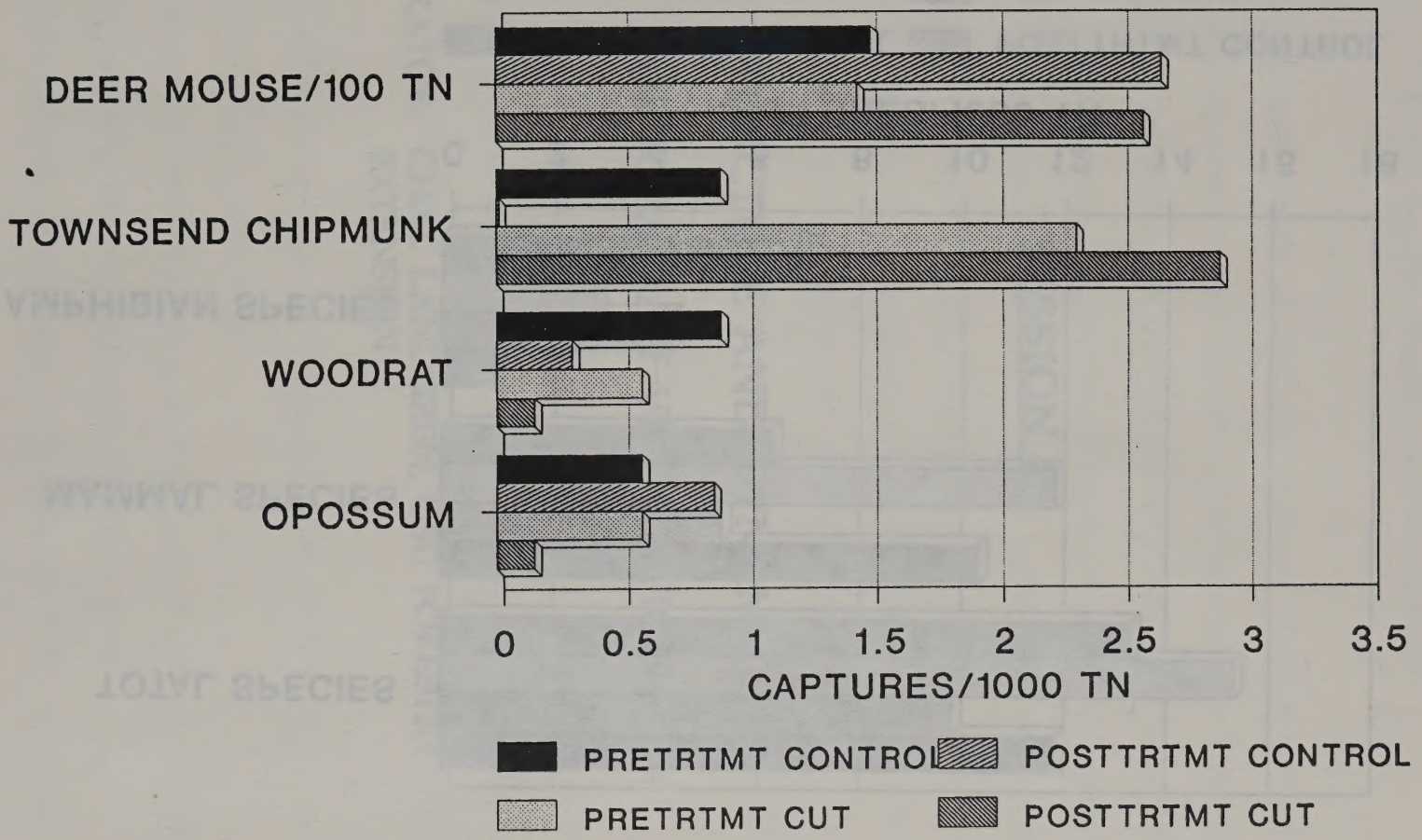
Red-backed vole



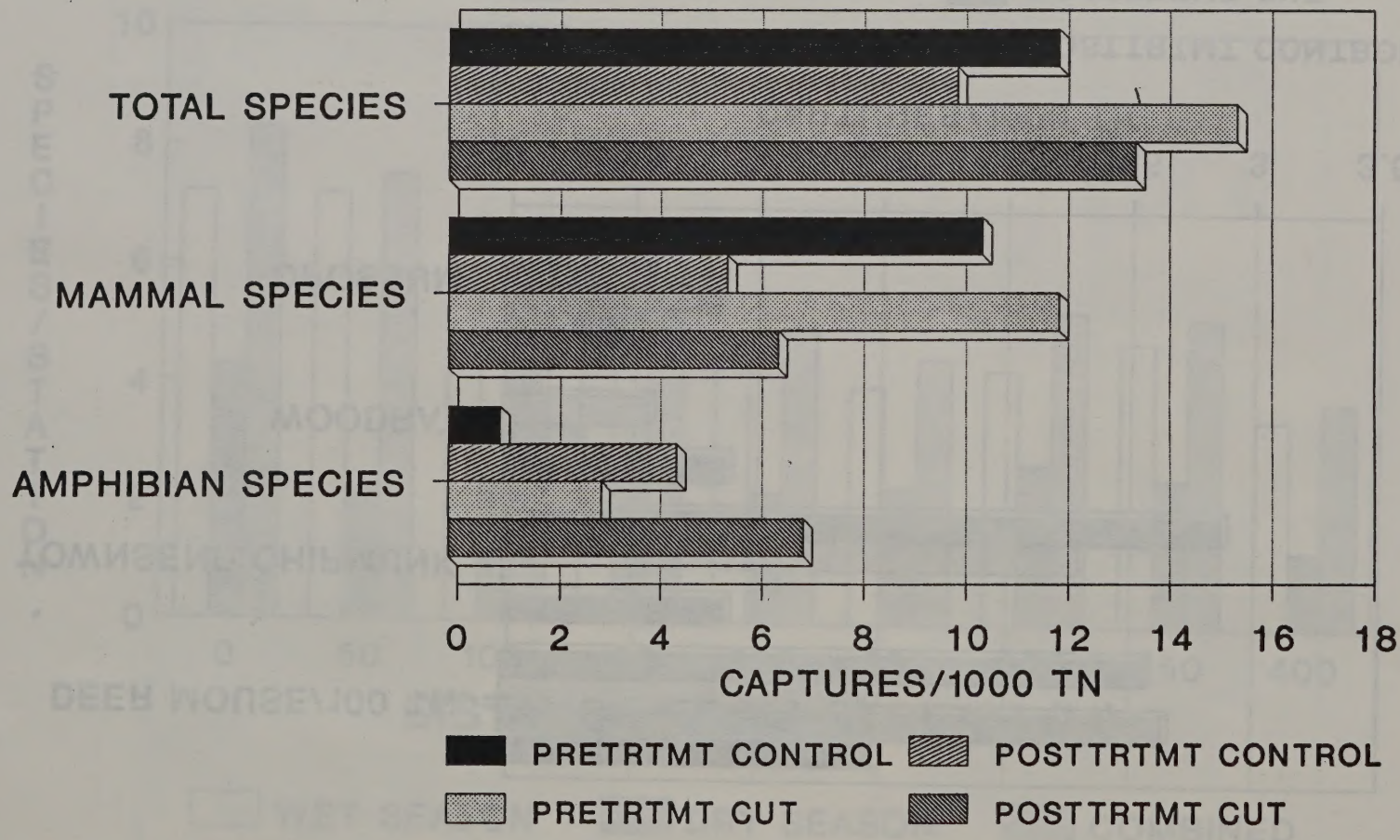
MAMMAL SPECIES RICHNESS ALONG THE TRANSRIPARIAN GRADIENT



DRY SEASON CAPTURES PRE- AND POST CLEARCUTTING ADJACENT TO STREAMS



DRY SEASON CAPTURES PRE- AND POST CLEARCUTTING ADJACENT TO STREAMS



SESSION II

STRUCTURE AND DYNAMICS OF RIPARIAN VEGETATION

MODERATOR: CHAL LANDGREN, OSU FORESTRY EXTENSION

DRY SEASON CAPTURES PRE- AND
POST CLEARCUTTING ADJACENT TO STREAMS
TOTAL SPECIES
MAMMAL SPECIES
AMPHIBIAN SPECIES
MODERATOR: CHAL LANDGREN, OSU FORESTRY
EXTENSION
POST-TREATMENT CONTROL
POST-TREATMENT CUT
PRETREATMENT CUT

Reproductive Ecology of Riparian Vegetation

- Project by John Zasada and John Tappeiner -

This presentation is based mainly on early results of our COPE research projects on shrub ecology and management. We consider "riparian areas" as those areas along streams in which the vegetation can be managed to enhance within stream processes and/or habitat. From our work it appears that riparian areas are productive because of often favorable soils and microclimate. However, our initial hypothesis is that plants in riparian areas, with the exception of those immediately adjoining the water, do not appear to behave differently than they do on upland sites. For example, salmonberry in riparian appears to have the same clonal and community structure as it has on upland sites. Also, its vegetative reproduction does not seem to differ between upland and riparian sites.

Probably the major shrub species in riparian areas is salmonberry, a clonal shrub, which under alder or in the open produces a "dense" network of rhizomes below ground and a continuous cover above ground. Our major findings to date regarding this shrub are:

a) In salmonberry communities beneath alders, rhizome density often exceeds 10 m/m^2 (5+ miles/acre).

b) There is a preformed bud in every 2-3 cm of rhizome with the potential for sprouting after disturbance to the aerial stems.

c) Above ground, salmonberry aerial stems form an unevenage stand with some new stems recruited each year, and some older ones dying. Thus it

appears that salmonberry will maintain a continuous cover once it is established unless treatments are used which severely reduce the bud bank in rhizomes, root crowns, and aerial stems.

d) Rhizome density is inversely related to overstory tree density.

e) After cutting salmonberry under alder, it resprouted to its initial stem density within 3-4 months. Cover was only about half of what it was before cutting. More time is needed to determine when salmonberry cover will return to precutting cover.

f) After clearcutting salmonberry aerial stem and rhizome density increases 3-fold. Pretreatment cover and stem density is reached within several months.

g) We found no evidence of conifer regeneration beneath salmonberry. (Also see references.) Control of both salmonberry and the alder overstory, if present, will probably be needed for conifer establishment.

h) Salmonberry can be readily controlled by glyphosate.

Our work on the regeneration of coast range shrub and hardwood species from seed indicate:

a) in contrast to vegetative reproduction, seedling establishment is a very slow process (exception is alder);

b) microsites that favor seedling establishment often occur in young stands that are self-thinning or being commercially thinned and in which dense understory has not yet formed;

c) microsites for seedling establishment in riparian areas may occur on logs or stumps or perhaps after flooding;

d) seedling reproduction is not likely to affect conifer establishment or other silvicultural practices in these areas;

e) As examples of development, 3-4 year old salmonberry and salal seedlings under forest stands were only 2-15 cm tall and had not yet begun to produce rhizomes and form clones. The taller salmonberry seedlings were often browsed.

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REPRODUCTION BY SEED OF SEVERAL COAST RANGE SHRUBS AND HARDWOODS

SPECIES	GERMINATION	SEED PREDATION	SURVIVAL AND GROWTH
BIGLEAF MAPLE	HIGH 40+% 1ST YR	HIGH 80+%	GOOD IN OPEN STANDS WITH LIGHT UNDERSTORY; LOTS OF BROWSING; NO DEVELPOMENT IN DENSE STANDS
VINE MAPLE	LOW/MOD.; 2YR+ GERM PERIOD	HIGH 80+%	PROBABLY SLOW GROWTH LOW SURVIVAL; BEST IN THINNED STANDS
SALAL	HIGH 90% 1ST YR	NIL	GENERALLY POOR; BEST IN YOUNG STANDS ON LOGS AND MOIST SUBSTRATES
SALMONBERRY	MOD. 20 TO 30%-BURIED SEED	LOW	"RAPID"GROWTH AND GOOD SURVIVALIN YOUNG STANDS AND CLEARCUTS--DEPENDS ON DENSITY OF GRASS-LOTS OF BROWSING .
ELDERBERRY	VERY LOW??	??	PROBABLY FAIR SURVIVAL AND RAPID GROWTH

USE OF AERIAL PHOTOGRAPHY TO QUANTIFY THE OVERSTORY STRUCTURE OF RIPARIAN ZONES IN THE COAST RANGE

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The condition and management of riparian zones is the number one land conservation issue in the United States (Elmore, 1987). In western Oregon, riparian zones comprise some of the most productive wildlife habitats in forested lands, characterized by high species diversity, density, and productivity (Anthony, et al., 1987). In western Washington and Oregon, approximately 359 species of vertebrates (excluding fish) utilize riparian zones for all or some of their life cycles (Brown, 1985).

The importance of riparian zones is not debatable. However, the question of maintenance and protection of riparian zones within conformance of the 1971 Forest Practices Act has generated a multi-sided conflict. Forestry practices have the potential to alter some or all of the structure and composition of the riparian zone and thereby influence the environment and structure of streams and rivers (Gregory et al., 1987).

In order to provide adequate management goals for riparian areas, a thorough understanding of the linkages within the systems is important. This includes quantitative data on vegetation composition, including vegetation type, classes, and densities, riparian zone structure and geomorphology, and any additional biotic and abiotic vectors influencing the riparian zone.

Riparian zones may be studied as either a bounded system, interacting with adjacent bounded systems, or, using an ecosystem analysis approach, they may be looked at from a basin-wide perspective, with interactions both from the basin and to the basin. In either case, these systems can be quite large and field collection of data can be quite expensive, time consuming, and often inaccessible.

For example, the Elk river basin, smallest of the three COPE selected basins, (Elk River, Drift Creek, and the Nestucca River), is composed of 34.8 miles of main river and 162.5 miles in 304 tributaries (Figure 1). Using an average buffer zone of 100 feet for the main river and 50 feet for the tributaries, the land base in riparian zones for the Elk river basin is about 2815 acres, (approx. 4.5% of the basin). Because the riparian zones can be quite variable, the sample size required to adequately represent the area would be quite large and would be quite expensive to implement. To this end, aerial photography used as a quantitative tool provides an important and under-utilized source of data for riparian zone management.

Color infra-red aerial photography of the three basins in the COPE program has been flown at a scale of 1:18000. Mapping work is currently underway using an analytical stereoplotter. Accuracy has been established for the instrument (Carson, 1985; Carson, 1986) and for the projects with horizontal accuracy of 3 to 5 feet in ground scale and vertical accuracy of 4 to 7 feet. Present work revolves around extensive mapping of the structural and compositional components of the overstory of the basins and

intensive mapping in selected study areas.

The histories of the three selected basins in COPE have an extensive variety of both natural and human events. These include natural fires over vast areas, debris torrents and large land movements, prescribed fire, logging and silviculture, road construction, and grazing. This has resulted in a large mosaic of landscape patterns.

With this in mind, it is not surprising to find it difficult to generalize about the riparian structure of these areas. Within one stretch of any given area, a number of structural differences may be found. Figure 2 shows an example of a section of Flynn Creek in the Drift Creek watershed that was burned by an intense fire in the 1880's and regenerated naturally. While one of the sub-basins regenerated in Douglas-fir, the adjacent sub-basin regenerated as an almost pure hardwood stand.

For the most part, the overstory composition of the riparian zones in the coast range is Douglas-fir for the conifer component and alder-maple for the hardwood component. The major exception to this would be the inclusion of spruce and hemlock in the coastal areas.

Figure 1. The Elk River drainage system as mapped from 1:18000 color infra-red photography. The basin contains 34.8 miles of main river and 304 tributaries (162.5 miles).

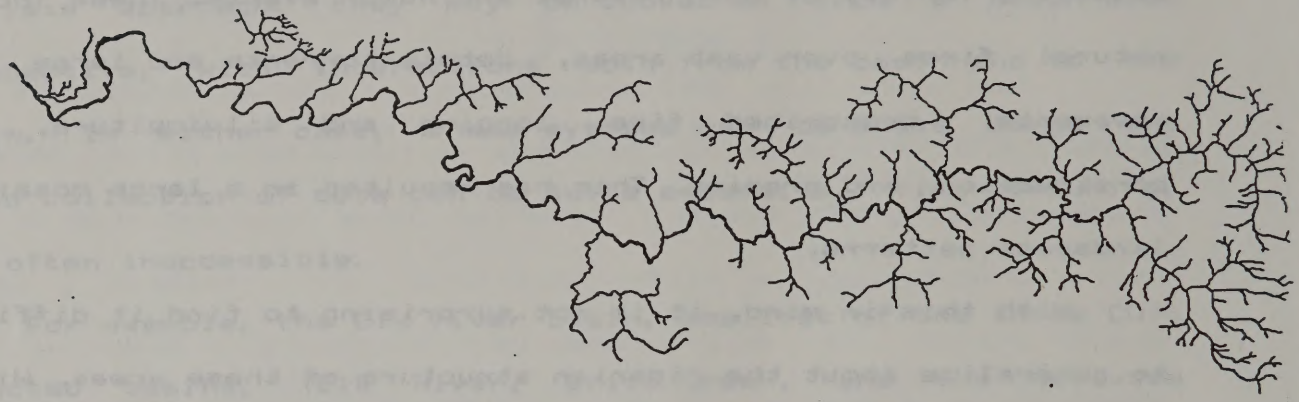
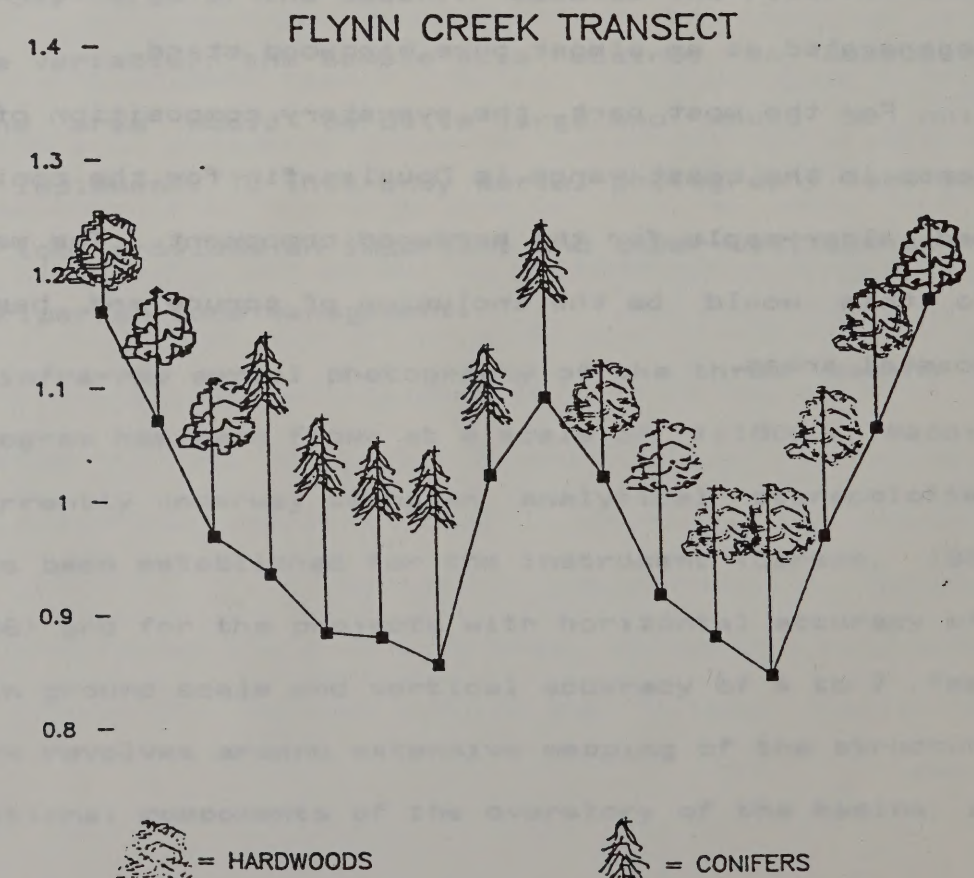


Figure 2. Transect of a section of the Flynn Creek drainage. This area was burned by an intense natural fire in the 1880's. Subsequent natural regeneration produced conifer dominance in one sub-basin and hardwood dominance in the adjacent sub-basin.



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COMMUNITY RESPONSE OF RIPARIAN VEGETATION TO FOREST MANAGEMENT

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The riparian zones of the Coast Range comprise some of the most productive forest ecosystems in the world. This potential is achievable, but is seldom achieved, because deliberate management is often constrained. A wide variety of management objectives are supportable in most riparian zones. With the exception of the hydric zones characterized by skunk cabbage, ninebark and willows in certain areas, most of the areas occupied by alder, salmonberry, elderberry, green indian plum and other characteristically lower-slope species, will grow a much wider variety of vegetation than they now support. Many have done so historically, and current plant cover is more a result of disturbance history than of innate potential. Management objectives determine what is desirable, and many end points are possible without damage to stream channel or cover.

Examination of most non-hydric riparian zones will reveal that historically, there were many large conifers present. Near the coast, these were often very large Sitka spruce. Western redcedar, western hemlock and Douglas-fir also occurred in riparian zones. Except for headwaters drainages, these conifers are generally mixed with salmonberry; in relatively recently disturbed sites, red alder is abundant, giving way to shrubs with age near the coast, and bigleaf maple, ash and willows in the interior of the Coast Range.

Most of the larger streams now pass through privately owned land with histories of clearing for agriculture, and various intensities of exploitation of the timber. Relatively few such sites have been in ownerships in which restoration to original forest types was high in priority. Removal of conifers has led to release of the residual hardwoods, seeding in of alder and/or release of salmonberry and other shrubs. In the event livestock was run on cutover areas, the recovery took a totally different form. Grazing was followed by loss of regeneration and sprouts of shrubs and hardwoods and replacement by mixtures of native and exotic grasses and forbs. Residual hardwoods often formed park-like stands with grassy understories which were replaced by sword fern and scattered shrubs when livestock were removed. Eventually, salmonberry and elderberry tend to dominate the ferns in this situation.

Deliberate silvicultural management places a very different form of selection on vegetation. Management systems to produce high yields of conifers are quite practical in non-hydric riparian areas. Removal of hardwoods and shrubs leads to excellent growth of Douglas-fir, western hemlock and perhaps Western redcedar and grand fir. If the shrubs and

hardwoods are killed outright, the conifers have freedom to grow at near-maximum rates on these nitrogen-rich sites. Similar preparation will lead to excellent growth in red alder. Without systemic control of shrubs, however, conifers will be replaced by sprouting salmonberry, and growth of red alder will be greatly slowed. Sprouting shrubs will strongly decrease the herb layer within four years. If herbs as well as shrubs are controlled for the first year of conifer or alder culture, herbs will reinvade as soon as the pressure of removal (herbicides, mechanical equipment) is removed. Seedling shrubs, especially introduced Himalaya blackberry and to a lesser extent salmonberry, take their places in the herb community. Within five years, shrubs are usually dominating space between planted conifers, and sometimes dominating conifers. If shrubs begin from sprouts, they are much more competitive.

Intensively managed riparian zones are affected by wildlife in several ways that influence response to management. Beavers have caused intense damage to alder plantations and mature hardwoods along streams. Deer and elk utilize weeded plantations intensively, and browse western redcedar, hemlock, Douglas-fir and alder. Damage is least on very large planting stock. Damage from antler rubbing is sometimes severe on planted hemlock and alder. Large stock does not solve this problem. The favorable attributes of conifer management on habitats of these wildlife species may therefore lead to heterogeneity in the managed stand unless these problems are anticipated, and protective measures taken.

Coast Range riparian zones have air drainage patterns that intensify frost damage. Red alder, in particular, is subjected to lethal damage in the form of girdling at ages up to three years and also to top dieback. This can happen in May, August, November, or any other time in summer. After crowns close, this is less of a problem. Freeze damage tends to eliminate most planted alder seedlings from depressions and other areas, such as valley confluences from which cold air flow cannot drain readily. Damage also occurs in Douglas-fir and hemlock, but less severely. Salmonberry and other shrubs are affected little or not at all, hence cold spots tend to be occupied first by herbs, then by shrubs or sprouting hardwoods.

Exotic herbs and shrubs have modified early succession in riparian as well as other zones. Early invaders after disturbance include many non-native grasses and herbs, including velvetgrass, ryegrasses, Australian fireweed, Senecio species and many others. Himalaya blackberry is much more widely distributed in forests than in the past, and is capable of converting riparian zones into monocultures within a few years, especially under a clearcut regime with no subsequent use of herbicides. Scotch broom and gorse, and more recently English holly, are troublesome in some areas. Holly has all the attributes of an ecological nightmare, i.e., it is bird-vectored, shade tolerant, and herbicide resistant; it sprouts copiously and has painful spines.

Areas in which winter water drainage is poor are varied in their ability to support conifers. Coastal areas with hummocks have the potential to support excellent spruce stands. However, establishment of spruce on scattered hummocks will seldom produce a commercial stand

because of the Sitka spruce weevil. Attempting to grow spruce beneath a partial stand of alder has been proposed, but not validated. Culturing of red alder on hydric sites may be successful if hummocks are high enough to offer substantial rooting depth. Poorly drained areas are generally poor sites for alder, and are usually poor risks for deliberate silvicultural management.

Established woody cover in riparian zones is highly competitive. Introduction of planted conifers or hardwoods is seldom successful without prior clearing and control of sprouting species. Occasional conifer recruitment occurs on large down trees. Sitka spruce and occasional hemlocks may appear this way, but seldom more frequently than as isolated trees.

Intense scarification of riparian zones will usually lead to pure alder in dense stands. This event preceded many of the stands currently widespread along streams of the Coast Range that had previously been dominated by conifers. When alder so invades, early stages will suppress most other species where stands are dense. If alder is cut in midsummer when in this condition, sprouting will be at a minimum, and there is a chance to replace with conifers. Development of grass cover and grazing will keep such sites in grass. After such conversion, conifers can be planted and spot sprayed with little brush problem.

Red alder has some features that limit its use as a riparian management species as the predominant component of stands. It is moderately vulnerable to breakage from ice storms. It is damaged by exposure, as along buffer boundaries. When clearcuts are adjacent to alder, sunscald and heat scorch from slash burns often decrease the efficacy of the remaining trees, either as a riparian forest crop, or as a source of tree cover. Its attractiveness to beavers is a significant risk factor. Despite these problems, alder will probably be present in many riparian forests even where conifers are desired, and a minor component will not seriously depress conifer productivity.

Removal of existing vegetation must accompany any serious reforestation effort. Removal by cutting leads usually to intense sprouting. Heavy machinery, applied intensively, is able to remove sprouters, but this degree of surface disturbance generally leads to dense alder and may also compact soil. Hand application of herbicides is possible with various selectivity patterns, leading to removal of sprouters with no physical disturbance, and no measurable effect on water quality or wildlife apart from changes in cover. When tall cover is present, it may be removed by felling. Where sprouting is to be controlled, a directed or broadcast treatment of sprouts with the appropriate chemical offers a minimum-disturbance approach to conversion. Various desirable vegetation types may be cultured with this method.

Management of riparian zones is possible to within a short distance of the stream with relatively little effect on water or channel. Reforestation or habitat enhancement to within 3 m of the stream bank is probably feasible in most situations where desirable. First, however, one must clearly articulate what the managed riparian zone is to deliver and when, and define the criteria by which the results are to be judged.

SESSION III

RIPARIAN SILVICULTURAL SYSTEMS

MODERATOR: CHAL LANDGREN, OSU FORESTRY EXTENSION

OREGON'S NEW FOREST PRACTICE RULES: AN OREGON DEPARTMENT OF FORESTRY VIEW

by

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ABSTRACT

The Oregon Forest Practice Rules are minimum standards intended to assure the continuous growing and harvesting of trees while providing for the overall maintenance of air, water, soil and fish and wildlife resources. The "new"[1] rules referred to in the title of this presentation are the riparian management area rules which went into effect in 1987. These rules clarified, redefined and added to the protection measures previously required around streams.

The Board of Forestry based the rule changes on information from a variety of sources but relied primarily on the "Report of the Riparian Habitat Technical Task Force". The task force was appointed by the State Forester and The Director of the Department of Fish and Wildlife and was comprised of foresters, fish and wildlife biologists, a stream ecologist and a water quality expert. The group used the best technical data and expertise available to formulate recommendations regarding management in the riparian ecosystem.

The rules which were developed by the Board define components of the riparian ecosystem and specify minimum and maximum protection widths (riparian management areas) around Class I streams within which special practices are required and certain practices prohibited. Minimum standards requiring shading and retention of live conifers, snags, and downed woody debris are also specifically prescribed.

Implementation of the new rules in 1987 required substantial training of Department of Forestry and Department of Fish and Wildlife personnel and forest operators and landowners. An understanding of new concepts such as riparian area, riparian area of influence and riparian management area as well as an understanding of how the new rules were intended to protect the riparian ecology was necessary so that intelligent site specific decisions regarding application of the rules could be made.

In the early stages of field application, Department of Forestry, Forest Practices Foresters, Department of Fish and Wildlife Biologists and industry foresters and landowners worked closely together in designing riparian management areas to meet the standards of the new rules. As industry foresters and landowners have become more familiar with the requirements, they now design most riparian management areas on their own. Forest

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1. Additional legislation was implemented in 1988, which requires forest operators to obtain approval of written plans for operations within 100 feet of Class I streams. This latest change is not addressed here.

Practices Foresters then monitor these areas for compliance with the rules, usually inspecting the areas prior, during and after harvesting. For operations on smaller ownerships, Forest Practices Foresters generally work with the landowner in designing the riparian management area because the smaller landowners often do not work with the rules frequently enough to fully understand the requirements. The Department of Fish and Wildlife and the Department of Forestry continue to work closely with all landowners to help accomplish their land management objectives while providing for the public resources in the riparian management areas.

Compliance with the new rules has been very good. Operators and landowners of all sizes have come to understand the minimum standards which the rules require. Generally, the riparian management areas that are left substantially exceed the minimum standards. This is attributable to an improved understanding of the values in these areas and to excellent cooperation and commitment among landowners, foresters, biologists and regulatory personnel.

While the requirements for riparian management areas established in the Oregon Forest Practice Rules are now understood, the end result in terms of benefits to the ecological system and costs to the forest landowner is not. The Cope program and other research programs are needed to provide scientific relationships about the riparian ecosystem. More often than not, landowners are not managing these areas very intensively, if at all. This is due to the regulations involved and the perception of many that these areas should be left untouched and not managed. It is far more likely that better scientific understanding combined with active management that focuses on <u>all</u> the resources in the riparian ecosystem will result in the greatest benefit.

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SYSTEMS FOR CONIFER ESTABLISHMENT AND GROWTH IN RIPARIAN AREAS

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Conifers can be important components of riparian zone forest stands by providing a long term input of large woody debris and continual development of large snags. These two functions will benefit both the fisheries and wildlife resources (see papers of previous section). Conifers growing within riparian areas can also provide a source of timber, a portion of which may be harvested under current Forest Practice Regulations.

As a result of past disturbances such as fire and logging, however, many Coast Range riparian areas are dominated by red alder stands, usually with dense shrub understories of salmonberry, and only a very scattered conifer component. The predominance of these stands has led some to assume that they are the natural riparian vegetation, but the presence of large conifer stumps indicates that many of these sites can support conifers (see also Newton paper). The scattered conifer component in these stands usually consists of understory trees that probably established at the same time as the alder canopy but were outgrown and suppressed. Otherwise, there is basically no evidence of natural conifer regeneration in alder-dominated riparian areas. Therefore, if conifers are desired in riparian areas then some sort of manipulation will be required to establish them or increase the growth of existing understory conifers.

Within COPE there are several studies just underway or being planned to investigate ways of establishing and growing conifers in riparian areas. One study is taking advantage of the suppressed, understory conifers already on some sites and testing whether they will respond to release. On an individual tree basis, holes will be punched in the alder canopy either by girdling or felling the overstory trees. The understory conifers will be monitored to determine if they respond to release and what rates of growth can be expected after release based on pre-release tree vigor characteristics. The individual tree method will have the advantage of simply opening holes in the existing canopy but basically leaving the canopy intact, resulting in a mixed species stand.

Another COPE study just beginning is looking at ways of establishing and growing conifers in riparian areas by planting them. In this study four species (Douglas-fir, grand fir, western redcedar and western hemlock) will be tested in three different overstory treatments and two understory treatments. The importance of animal damage will also be tested by protecting half of the seedlings. Analysis will include measures of the light and soil water environments of the seedlings to begin to determine what levels of these factors are limiting survival and growth of each species. Tests of this nature will be expanded upon by a Fundamental COPE study to include a range of the possible light, temperature and water environments.

An important aspect of silvicultural systems in the riparian areas will be tying these treatments in with activities in adjacent upslope stands. This

will limit the number of entries into a stand and, in most cases, improve the accessibility of the riparian area. The logical way to do this is to extend the upslope silvicultural treatment to the stream. The effect of such treatments will be tested by the Fundamental COPE study, probably by setting up an experimental/demonstration area with alternative silvicultural practices applied from the ridge-top to the stream. Possible practices for testing include: clearcuts, with and without a buffer; "sloppy clearcuts" or green tree retention cuts; and uneven-aged management.

All of these tests will help define exactly what it takes to establish conifers along riparian zones. If fisheries and wildlife studies are successful in determining exactly what riparian vegetation characteristics are desirable for each of these resources along selected reaches of streams, then silviculturists will have the tools to enhance the productivity of the system.

Recommended Readings

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LONG-TERM MANAGEMENT OF RIPARIAN VEGETATION FOR MULTIPLE OBJECTIVES

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Most casual viewers of vegetation communities tend to expect the plants to look the same today, tomorrow, and next year. But plant communities are extremely dynamic. Riparian communities, with both internal and external sources of disturbance, are more dynamic than most. To maintain and manage the ecological resources of riparian communities, we must examine their behavior over the long term. There are four specific areas of long-term concerns that I want to address.

The practice of leaving buffer strips along streams to protect ecological values makes sense - in the short run. A reasonably intact vegetation community is left to buffer external influences and to maintain the continuity of the vegetation community. However, buffer strips appear to be inherently unstable, both physically (wind-fall in some locations) and biologically. Creating a buffer strip accelerates succession and, especially in alder-dominated communities, leads first to the development of dense shrub understories. Later, with accelerated tree senescence, a shrub-dominated, not tree-dominated community is left.

Opportunities for regeneration must be made (also see talk by Mike Newton). For successful establishment, tree seedlings will need a reduction in competition and, probably, animal damage protection. These regeneration windows are needed both at the creation of the buffer strip and through time as the community continues to develop.

Large conifer trees are needed as a source of coarse woody debris for stream structure. Some recent evidence suggests that our current density management practices keep stands too dense to ever produce very large trees. First, the tree may be structurally unstable (not enough diameter for the height) and so break before they become very tall. Second, stands of trees may self-thin differently depending on early stand density. Very large trees may only develop from stands that were widely spaced early on.

The diversity of the riparian plant community is considered to be one of its unique and highly-valued features. Yet, most of our experience is with managing monocultures. One approach to managing for diversity is to create small monoculture patches. This creates some logistic problems but no new biological ones; and many riparian communities are structured as small patches. Another approach to management is mixtures on a plant by plant basis. There are some keys to the stability and long-term management of these mixes being developed from the self-thinning rule.

Further Reading

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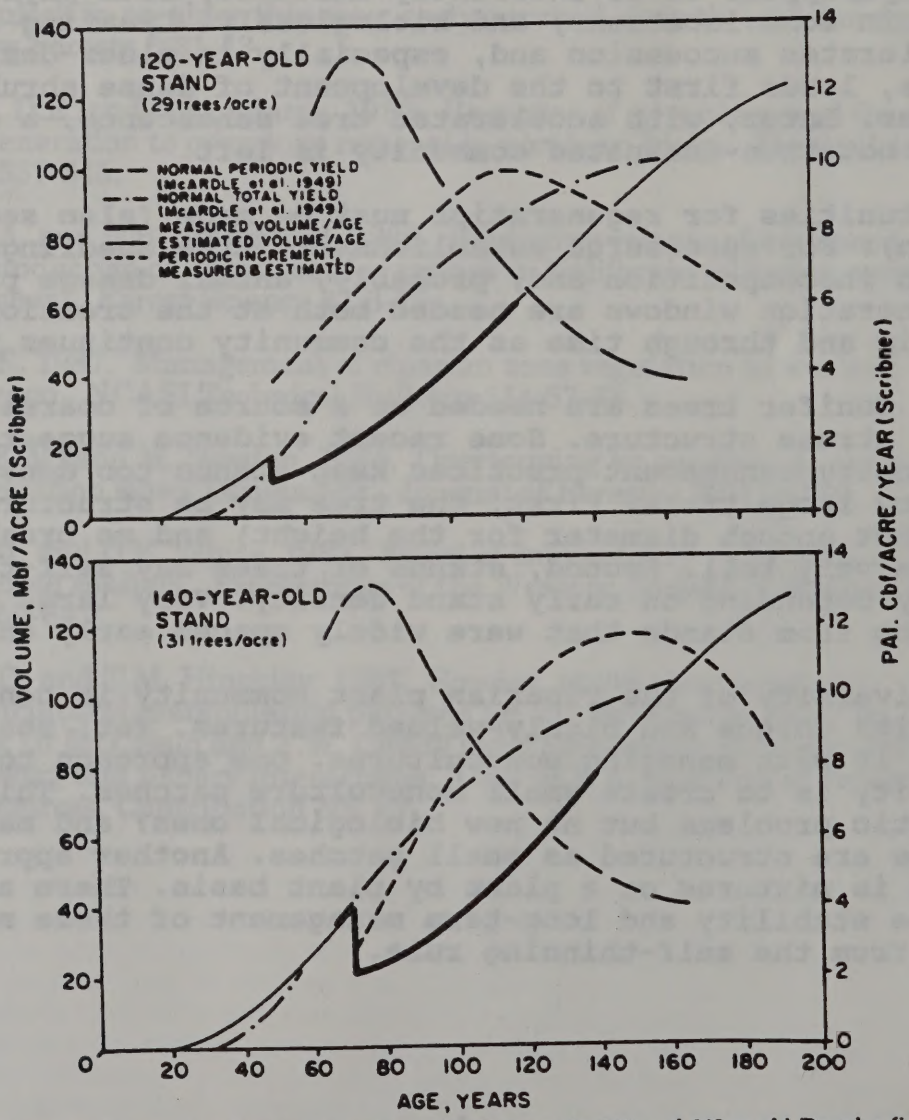
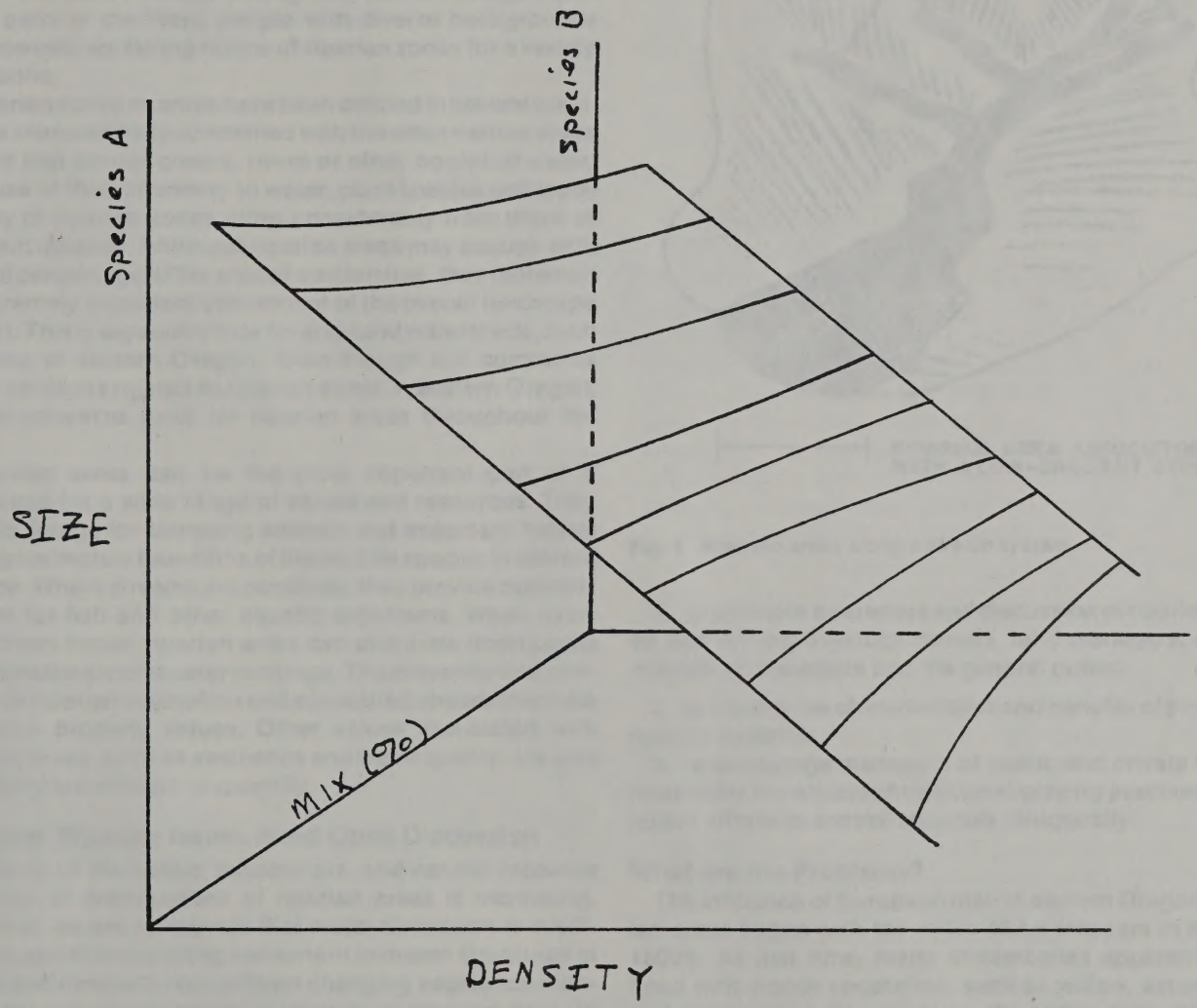


Fig. 1. Observed and estimated volume development in 120- and 140-yr-old Douglas-fir stands after heavy cutting at ages 50 and 70 yr, respectively.



A Self-thinning Surface for a 2 Species Mix

Riparian Areas: Perceptions in Management

Wayne Elmore and Robert L. Beschta

A Narrow Strip of Land

Until a few years ago, the phrase "riparian zone" was used primarily by researchers and managers in the arid Southwest. Their primary concern was the role of streamside vegetation (phreatophytes) in water loss from streams. Such is no longer the case. Today, throughout eastern Oregon and other parts of the West, people with diverse backgrounds and interests are taking notice of riparian zones for a variety of reasons.

Riparian zones or areas have been defined in several ways, but we are essentially concerned with the often narrow strips of land that border creeks, rivers or other bodies of water. Because of their proximity to water, plant species and topography of riparian zones differ considerably from those of adjacent uplands. Although riparian areas may occupy only a small percentage of the area of a watershed, they represent an extremely important component of the overall landscape (Fig. 1). This is especially true for arid-land watersheds, such as those in eastern Oregon. Even though our comments focus on issues related to riparian zones in eastern Oregon, similar concerns exist for riparian areas throughout the West.

Riparian areas can be the most important part of a watershed for a wide range of values and resources. They provide forage for domestic animals and important habitat for approximately four-fifths of the wildlife species in eastern Oregon. Where streams are perennial, they provide essential habitat for fish and other aquatic organisms. When overbank flows occur, riparian areas can attenuate flood peaks and increase groundwater recharge. The character and condition of riparian vegetation and associated stream channels influence property values. Other values associated with riparian areas, such as aesthetics and water quality, are also important but difficult to quantify.

Complex Riparian Issues Need Open Discussion

Interest of the public, landowners, and natural resource agencies in management of riparian areas is increasing. However, we are concerned that much discussion is misdirected, and that installing permanent instream structures in rangeland riparian areas without changing vegetation management will be counterproductive over the long haul. In addition, we suggest that several important issues that are not being addressed need to be subjected to the rigor of public discussion. Thus, the objectives of this paper are:

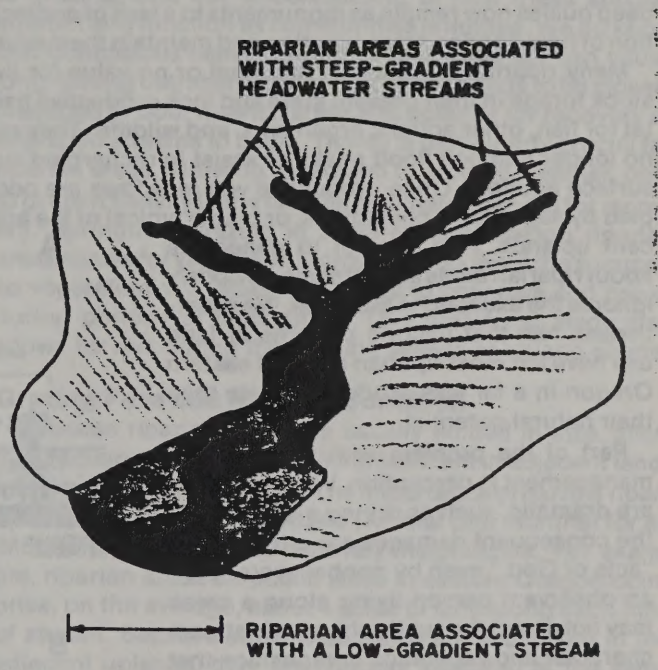


Fig. 1. *Riparian areas along a stream system.*

1. to promote awareness and discussion of riparian issues by and among livestock owners, land managers, environmentalists, biologists and the general public;
2. to identify the characteristics and benefits of productive riparian systems;
3. to encourage managers of public and private lands to reconsider the effects of traditional grazing practices and of recent efforts to control channels structurally.

What are the Problems?

The influence of European man in eastern Oregon's riparian areas began with the influx of fur trappers in the early 1800's. At that time, many streambanks apparently were lined with woody vegetation, such as willow, aspen, alder, and cottonwood. For example, the Indian term "Ochoco," which was used to name a mountain range in central Oregon, means "streams lined with willows." Widespread beaver trapping initiated changes in the hydrological functioning of riparian areas and streams. Beaver ponds, which had effectively expanded floodplains, dissipated erosive power of floods, and acted as deposition areas for sediment and nutrient-rich organic matter, were not maintained and eventually failed. As dams gave way, stream energy became confined to discrete channels, causing erosion and downcutting.

Homesteaders and ranchers followed the trappers. Grazing practices on the rangelands of eastern Oregon were similar to those throughout much of the West and relied primarily on year-long or season-long (April-October) use.

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These practices allowed livestock to concentrate their foraging in riparian areas, rather than on the adjacent hillslopes. As a result, many of the riparian areas in eastern Oregon are in a state of disrepair and degradation. Streams that were a perennial water source for early settlers may no longer flow in late summer. Channels that once handled spring runoff and summer freshets easily are now unstable and eroding. Where channel gully erosion proceeded unabated, extensive deep gullies now remain as monuments to a lack of appreciation of how riparian areas function and maintain themselves.

Many riparian areas are of marginal or no value for livestock forage in their present state and lack productive habitat for fish, other aquatic organisms, and wildlife. They may no longer dampen flood peaks or assist in recharging subsurface aquifers. Once-productive wet meadows are occupied by sagebrush, cheatgrass, or plants typical of the adjacent uplands. Any attempt to generalize about riparian areas and streams obviously ignores the exceptions that exist. We nevertheless feel that historic patterns of land use have left most riparian areas of eastern Oregon in a far less productive state than their natural potential.

Part of the problem with riparian-area management is perception. When changes are dramatic, such as during a large flood, the consequent damages are attributed to "acts of God," even by nonbelievers. Even an observant person living along a creek may not detect the subtle changes in stream character and vegetation composition that are occurring with time. While each generation may be aware only of seemingly small and incremental changes, the cumulative effect of these changes over long periods of time can be substantial. Many people have never seen a "healthy" rangeland riparian area, since degradation was widespread before many of us were born. The whole picture may not be obvious even to oldtimers, because many changes occurred before the turn of the century. Attempts to establish what presettlement stream systems and riparian areas were like by searching the early literature are not always successful. Journals of early fur trappers and ranchers, however, do provide glimpses of how riparian areas may have looked originally—glimpses showing that significant changes have occurred.

The Fallacy of Floods and the Fortitude of Vegetation

We often assume that floods inevitably have undesirable impacts. While flood damage may be great in watersheds with deteriorated riparian and upland areas, floods are not always catastrophic. Streams typically transport large amounts of sediment during floods, and sometimes channel changes are swift and desirable. However, on streams with sufficient diversity and cover of riparian vegetation, bank building through the deposition of sediment occurs during high flows.

The exact species composition of riparian vegetation varies from area to area and depends on elevation, soils, geology, topography, and climate. Generally, plants with strong root systems are required to hold streams and riparian zones together. In eastern Oregon, the willows, sedges, and rushes fit this requirement admirably. Their stems provide roughness and resistance to flow. At high flows these species bend but do not break, and they are extremely effective at trapping sediment transported by the stream. Their root systems, in conjunction with other herbaceous vegetation, usually can resist a stream's erosive power. The importance of these species in maintaining bank stability, filtering, and depositing sediment has long been underrated; they are essential to

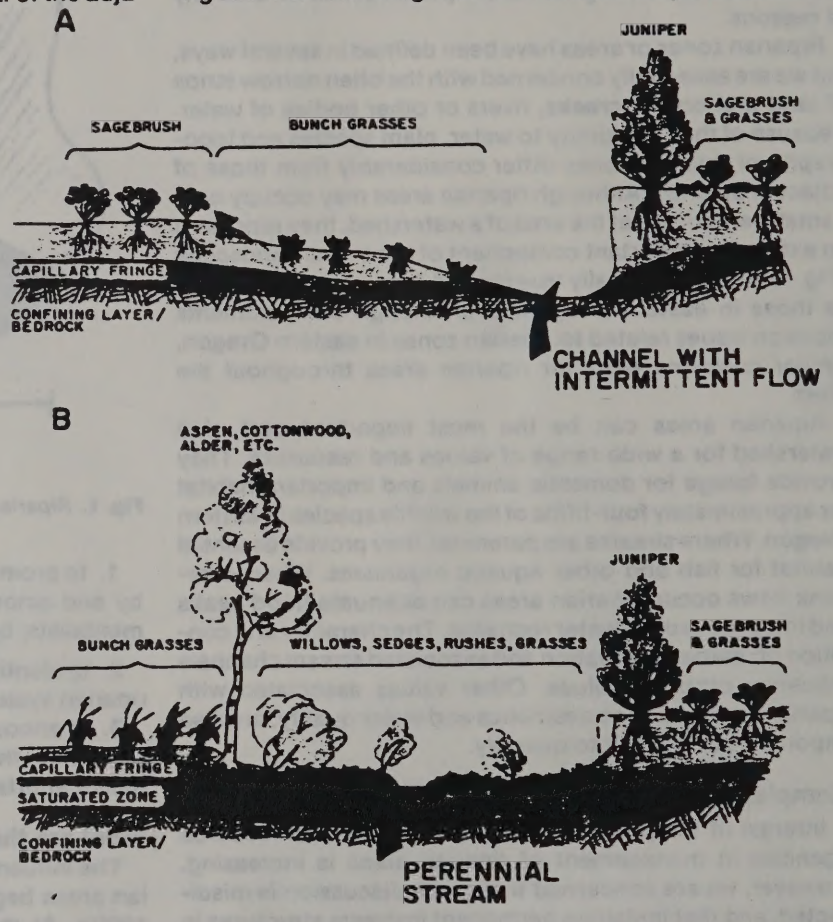

Fig. 2. *General characteristics and functions of riparian areas.*

(A) Degraded riparian area

- *Little vegetation to protect and stabilize banks, little shading*
- *Lowered saturated zone, reduced subsurface storage of water*
- *Little or no summer streamflow*
- *Warm water in summer and icing in winter*
- *Poor habitat for fish and other aquatic organisms in summer or winter*
- *Low forage production and quality*
- *Low diversity of wildlife habitat*

(B) Recovered riparian area

- *Vegetation and roots protect and stabilize banks, improve shading*
- *Elevated saturated zone, increased subsurface storage of water*
- *Increased summer streamflow*
- *Cooler water in summer, reduced ice effects in winter*
- *Improved habitat for fish and other aquatic organisms*
- *High forage production and quality*
- *High diversity of wildlife habitat*

the integrity of stream channels and associated riparian areas.

Vegetation Is Important for Summer Streamflow

Riparian studies historically have been associated with efforts to reduce evapotranspiration "water losses" by removing streamside vegetation (primarily shrubs and trees). Such management practices were primarily intended to increase streamflow. While trees and shrubs can evapotranspire more water over the course of a year than might evaporate from bare soil, this simple scenario ignores the more important beneficial hydrological consequences that shrubs (and trees, in some cases) can have in riparian areas.

Woody species often provide local channel stability and and resistance to channel erosion so that other species (sedges, rushes, grasses, and forbs) can become established. As vegetation becomes established and total biomass increases along a stream, channels typically begin to aggrade (i.e., channel elevation will increase as sediment is deposited within and along the banks of the channel). With continued sediment deposition and bank-building, particularly along low-gradient channels, water tables rise and ultimately may reach the root zone of plants on former terraces or flood plains. Species composition and community structure of vegetation occupying terraces or flood plains change dramatically, becoming dominated by typical riparian species. It should be noted that accelerated soil erosion from upland areas is neither needed nor desirable to produce the sediment necessary for bank building. Natural erosion rates typically provide enough sediment for successful recovery of a riparian area (Fig. 2).

An aggrading channel and a rising water table have many benefits. More water is stored during wet seasons, and slow release of this water may allow a stream to flow during the driest of summers. Hence a paradox: establishment of additional vegetation in degraded channels can cause a stream to flow throughout the summer. Summer flows have improved in a variety of streams in eastern Oregon where riparian vegetation has been allowed to recover and stream channels have begun to aggrade. Such responses are happening in areas that receive, on the average, only 10 to 15 inches of annual precipitation. The important point is that streamside vegetation provides the key to improving the productivity and stability of riparian systems. This vegetation is also critical in reestablishing perennial flow in degraded channels, where the slow release of water from increased subsurface storage can more than offset the amount used by streamside vegetation.

To Graze or Not to Graze

Adverse changes in streams and riparian vegetation can result from a wide variety of causes: changing climatic and precipitation patterns, more frequent flooding, altered beaver populations, heavy streamside grazing, improper use of upland watersheds or adjacent slopes, road construction close to channels, and others. On a geologic time scale, persisting uplifting of terrain may cause streams to entrench. Yet, when we look at all the factors that can and do influence the present condition of riparian areas in the West, livestock grazing is unquestionably a significant factor. Since grazing is intrinsically associated with the problems, it is also fundamentally important in the solutions. Grazing management provides a major opportunity to improve riparian areas without large expenditures of money.

In the past, rangeland management and research have focused largely on trying to understand and increase productivity from upland areas and plant species. Because the riparian community occupies such a small portion of a watershed (less than 0.5% of eastern Oregon rangelands), it may have been assumed that riparian plants responded to grazing pressure similarly to upland species. Unfortunately this is not the case. Species in "recovered" riparian areas are numerous and diverse in their requirements and responses to grazing, and our understanding of how these species interact and function as communities is limited. We do know that continuous heavy grazing of riparian areas can cause long-lasting detrimental effects. Grazing needs to be closely managed in both riparian areas and uplands for recovery of degraded streams to begin. Timing is particularly crucial for riparian areas. Allowing vegetation to grow all summer, only to graze it heavily in the fall, can eliminate chances for recovery. Springtime grazing in some eastern Oregon riparian areas allows for vegetation regrowth throughout the summer, so vegetation still provides stability to channels and banks during periods of high runoff. This grazing strategy also allows for rest during the growing season of upland plants.

Grazing Fees and Riparian Condition

Because riparian areas are usually limited in size, allotment administration usually includes them in adjacent landforms and vegetation types. The importance of narrow riparian areas in allocation of AUMs (Animal Unit Months) for an allotment thus becomes relatively insignificant. For example, riparian areas on public lands in eastern Oregon comprise, on the average, about 4 acres of land along each mile of stream. Because streamside zones are subsumed in the adjacent uplands, they are typically allocated at the same intensity of forage use, often only one AUM for every 13 to 16 acres. Assuming the current public land grazing fee of $1.35 per AUM, the revenue from grazing in riparian zones is approximately 35 to 40 cents per mile of stream. Riparian vegetation actually is grazed more intensively than any other portion of an allotment, and at a rate much greater than one AUM per 13 acres. Consequently, forage on the rest of the allotment often is underutilized. As a result, the overall health of riparian zones continues to decline because of concentrated livestock use along streams.

Efforts are currently underway in Congress to raise livestock grazing fees. With respect to riparian areas, however, the dollar value of an AUM should not be the issue. Instead, we need to focus on management of the land. Riparian management will not improve just because more is charged for using these lands. Perhaps no fee should be charged when management is improving the riparian area, but a high fee for areas where current management precludes recovery. We need to concentrate our efforts on improving riparian vegetation and companion resources—that's the real issue.

Grazing Strategies and Riparian Recovery

Some people consider the current condition of riparian areas to be acceptable; however, we suggest that it is not acceptable along many streams. The continued use of grazing systems that do not include the requirements of riparian vegetation will only perpetuate riparian problems. Ranchers and managers of public lands need to select riparian areas for long-term demonstration sites where nontraditional grazing strategies can be tested and the results compared with naturally recovering systems. These strategies should be

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directed toward the recovery of both biological systems (vegetation diversity and structure) and physical systems (channel characteristics and hydrology) and should entail various seasons of use, levels of utilization and exclusion, classes of livestock, and so forth. Such demonstration areas would provide important reference sites against which the characteristics of riparian systems managed in the standard manner can be evaluated. Describing and monitoring channel characteristics and streamside vegetation should be an important component of these demonstration studies.

Demonstration areas that are established need to be continued over several years, for the recovery of riparian areas is not always rapid. Time is required for Mother Nature to work her magic, and changes may not be obvious within the first few years. Where a channel is currently beginning a cycle of erosion, seed sources for native riparian species are absent, channel gradients are steep, or silt loads are low, recovery may require decades or longer. From the perspective of future generations, perhaps the actual rate of recovery is relatively unimportant, as long as management is nudging streams and riparian systems in the "right" direction.

Recovery can be extremely rapid along low gradient streams that traverse alluvial valleys were streams carry substantial loads of silt during high flows. As production of vegetation increases, these areas may appear to be productive and stable systems once again. However, initial vegetation "expression" should not be confused with vegetation "succession" (Fig. 3). As vegetation succession progresses, the plant diversity in riparian areas increases greatly. Channel characteristics also change. Wide shallow channels, with either flattened banks or steep eroding cutbanks, are replaced by narrower, deeper, and more stable channels with well-vegetated banks.

AUMs and Ecosystem Health

Recently there has been considerable debate about excluding livestock from riparian areas as the solution to the riparian problem." In some cases, such a drastic change may be the most appropriate way to begin recovery. For many streams, however, total livestock exclusion is not necessary; livestock grazing and healthy riparian systems can coexist even during recovery. Although the season and intensity of use need to be controlled carefully, experience in eastern Oregon is beginning to show that the number of available AUMs in many riparian areas can increase as recovery occurs.

When vegetation succession starts and the riparian system begins to function properly, it moves towards a more productive and healthy ecosystem (Fig. 3). At this point, all the benefits of a healthy riparian area will begin to reappear, including increased AUMs for livestock, improved habitat for wildlife and aquatic organisms, more stable channels, improved water quality, a shift toward perennial streamflow, reduced flood peaks, and others (Figs. 4, 5, 6, and 7). Allowing grazing only at certain seasons is an investment in the health of the riparian system, and this investment will pay off in improved future productivity.

Once recovery is underway, it is tempting to relax management prescriptions and return to previous grazing practices. Early successes in forage production may intensify the pressure to increase AUMs immediately. It's hard to leave "unused forage" along a healthy riparian area, but it must be left to maintain the integrity of the system. A few years of grazing at inappropriate times can quickly undo what may have taken years to establish.

Each Steam System Is Unique

Each stream has unique combinations of channel morphology, streamside vegetation, hydrology, geology and soils, and so forth. The vast array of conditions may lend credibility to the concern that the pattern of riparian recovery observed on certain streams may not occur on other stream systems. Our knowledge of recovery rates is indeed imperfect, and quantitative predictions are not always reliable on a site-by-site basis. Additional research on arid-land riparian systems is certainly needed to improve understanding of many questions:

1. Which riparian areas have the greatest potential for vegetation response (increased productivity and species diversity)?
2. In which areas will vegetation succession occur quickly, and what pathways will this succession take?
3. Which streams have the greatest capacity for storing subsurface water and regulating stream flow?
4. Which streams have the greatest potential for filtering and storing sediment and improving water quality?
5. Which riparian areas have the greatest potential for increased AUMs, and how can the preferred timing and intensity of use be determined?
6. To what extent will habitat for wildlife and fish improve?

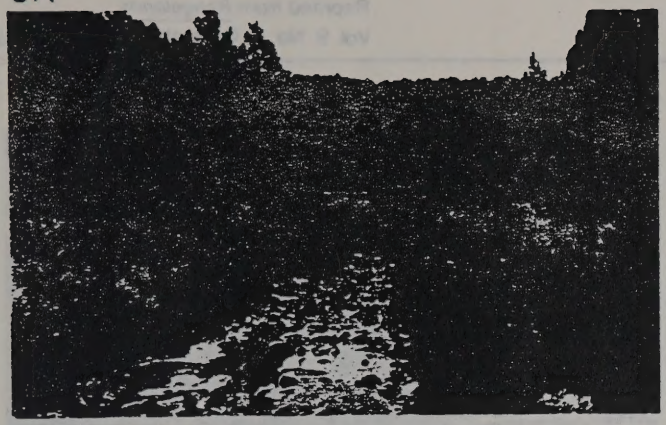
These major gaps in our knowledge indicate tremendous opportunities for research and innovative management as we move toward understanding the function of riparian areas and the wide array of benefits they provide. It is perhaps a sad commentary that, with few exceptions, researchers and managers have long ignored opportunities for managing riparian areas. Some managers, preoccupied with a lack of knowledge about the ultimate potential of riparian sites, may use this as a rationale for taking no action. This is folly. Perhaps the major question to be addressed, given our current state-of-the-art, is—*are we allowing succession to occur?*

Structures and Streams

Many proponents of improved riparian management would like to spend large amounts of money to correct riparian problems. Additional funds are needed to assist in changing grazing strategies, but only spending large amounts of money to build instream structures (e.g., gabions, dikes, check dams, rip-rap, sills) or structurally modify channels will seldom "solve" riparian problems. Building expensive instream structures without solving the problems associated with management of riparian vegetation allows managers to sidestep difficult decisions.

By placing permanent structures in a channel, we are attempting to lock the stream into a fixed location and condition. However, alluvial streams naturally develop and function by continual channel adjustments as flow and sediment loads vary. These incremental changes allow streams to withstand the wide range of dynamic forces that occur as flows fluctuate rapidly during storm runoff. None of the changes in channel characteristics and riparian vegetation shown in Figures 3 through 7 resulted from structural additions to the streams. Even where structural additions to a channel may help recovery, we often install structures in sections of stream where they are not needed, because we rarely allow several years of vegetation recovery before identifying where they might do the most good. Improvement of riparian areas cannot be expected without changes in grazing management.

3A



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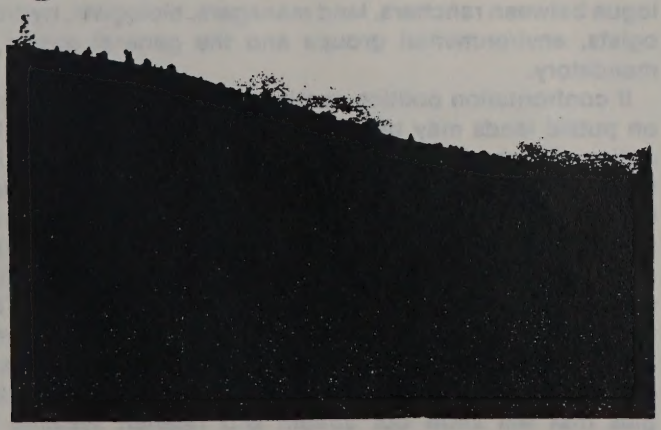

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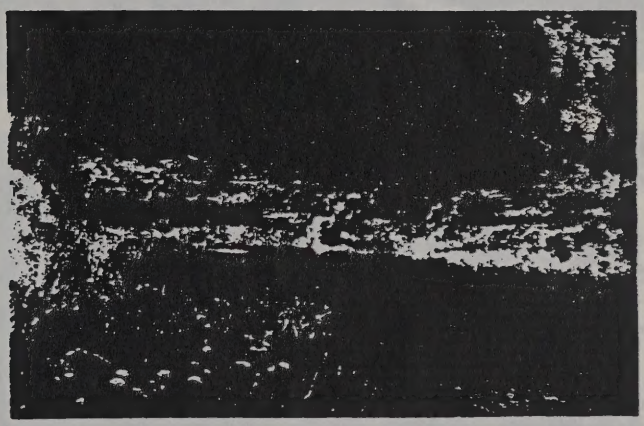

Fig. 3. *Vegetation "expression" (A) versus vegetation "succession" (B). The "expression" photo, taken in 1976, reflects species present under heavy grazing that were simply allowed to mature. The "succession" photo, taken in 1984, shows changes that can occur as grass, willow, sedge, and forb species increase. Note the narrowed channel and the well-protected, overhanging banks of the recovered stream.*

Fig. 4. *Vegetation and channel responses (A) and (B) after 3 years of rest followed by spring (May) grazing. Note the decreased width and increased sinuosity of the stream channel as recovery proceeds.*

Fig. 5. *Ten years (1976-1986) of vegetation and channel responses (A) before and (B) after 5 years of rest followed by 5 years of a late winter (Feb)/early spring (March) grazing system. Grazing use increased from 72 AUMs in 1976 to 313 AUMs in 1986. In 1976, banks were poorly defined and the stream was actively eroding the steep cutbank on the left. In 1986, the cutbank had been stabilized by vegetation. The channel had also narrowed, as vegetation stabilized stream banks being built from sediment deposits.*

In the rush to install expensive and often counterproductive structures, we have ignored what should be the primary management focus—restoring streamside vegetation. In contrast to structures, riparian vegetation can maintain itself in perpetuity as new plants continually replace those that die. Riparian vegetation allows streams to function in ways that artificial structures cannot replicate. The resiliency that these plants provide allows riparian systems to withstand a variety of environmental conditions.

The View at the Crossroads

We have presented several issues and concerns that can

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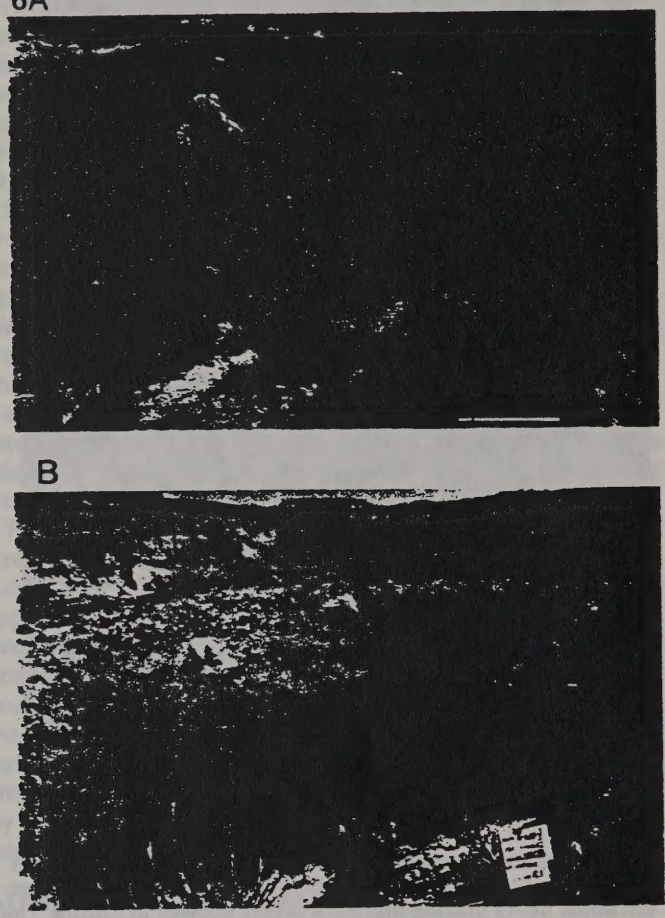


Fig. 6. *A wide, entrenched channel system that has incised 5 to 15 feet into silty-clay deposits. View (A) shows the area in 1968. View (B) shows the same area 16 years later, after exclusion from grazing. Note the expanded riparian area, as the water table influences vegetation composition across the entire bottom. Perennial streamflow does not occur during relatively dry summers either upsteam or downstream of the exclosure. Within the recovered section, however, the stream now flows continuously even during dry summers.*

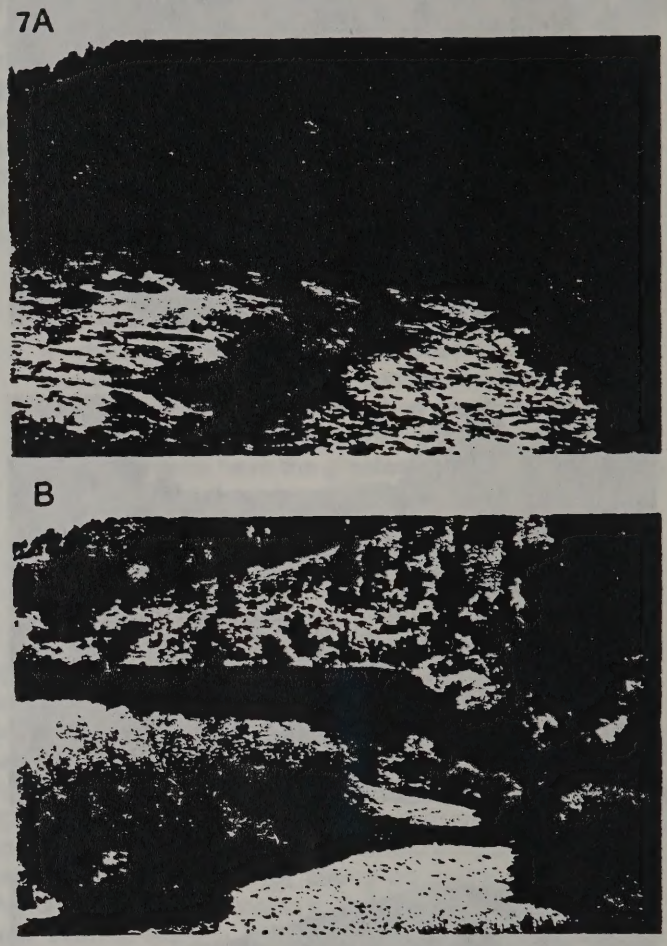


Fig. 7. *Vegetation and channel responses (A) before and (B) after 8 years of exclusion from grazing. Water now flows throughout the summer in a formerly ephemeral channel. The channel bed is gravel but previously was primarily fine sediments (silts and clays). These fine sediments are now being deposited at high flow—for example, on the left bank. The steep cutbank in the background, along the right side of the stream, is no longer being actively eroded by the stream.*

significantly affect the approach to managing riparian areas. Private land owners and users and managers of public lands need to reconsider the effects of current management activities on riparian areas. All riparian areas cannot be improved immediately to improve the functioning of riparian systems to arrive at productive and self-perpetuating riparian areas.

A word of caution is appropriate. As we endeavor to focus on restoring and enhancing the unique attributes of riparian areas, we must not forget the need to manage upland areas properly. Upland areas occupy up to 99% of eastern Oregon's rangeland watersheds and are an essential component of any land-management program. They also influence profoundly the ultimate character of the downslope riparian areas.

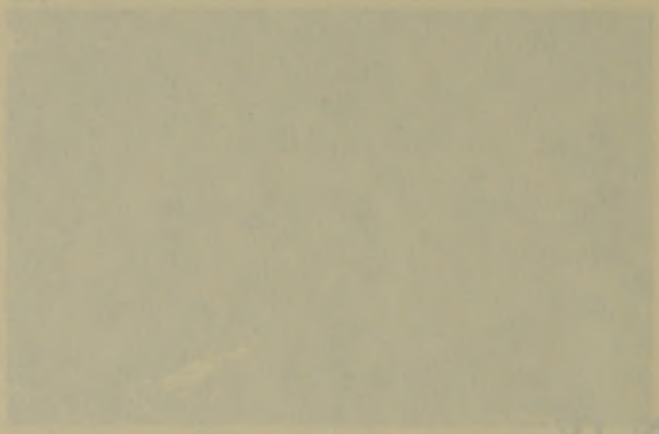
We are at an important crossroads in the management of riparian areas. Members of the livestock industry can provide leadership in understanding and solving complex riparian questions. Their support is critically needed for studies that will have long-term payoffs. More importantly, they need to support changes in grazing strategies and other uses in managed riparian areas. A fresh start at establishing dialogue between ranchers, land managers, biologists, hydrologists, environmental groups and the general public is mandatory.

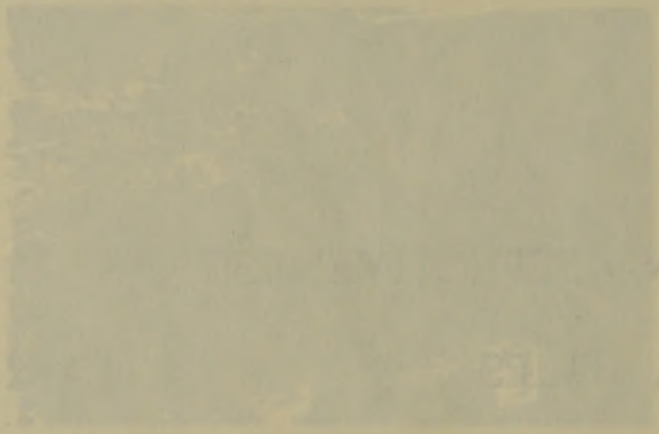
If confrontation politics continue, grazing riparian areas on public lands may be eliminated, and we may lose the option of managing riparian systems for livestock production. The American public is becoming increasingly involved in both public and private land use issues, even though most people live in urban areas well away from rangelands. If the riparian management issue were placed on a national ballot today, is there any doubt which way the vote would go? The timing is ripe for ranchers and other land managers who operate on private or public lands (riparian vegetation doesn't know the difference) to initiate management strategies that will allow our stream and riparian systems to approach their productive potential.

SESSION IV

IMPLEMENTATION AND EFFECTIVENESS OF BUFFER STRIPS

MODERATOR: PAUL ADAMS, OSU FOREST ENGINEERING DEPARTMENT





CURRENT RIPARIAN MANAGEMENT POLICIES AND MONITORING IN THE PACIFIC NORTHWEST

by

David Morman
Forest Practices Monitoring Coordinator
Oregon State Department of Forestry

ABSTRACT

The purpose of this presentation is to provide an overview of the state forest practice riparian regulations in coastal Oregon, Washington, and California and to briefly describe efforts underway in the three states to monitor the effectiveness of these regulations.

While protection of riparian areas have always been a central element of the three state's forest practices rules, the mid-1980's saw renewed interest in ensuring that the minimum protection standards provided by the rules were adequate. As a result, each state revised its riparian protection regulations.

In their present forms, coastal riparian regulations in the three states address several common elements. They include:

- Classification of waters into categories which match protection measures to the beneficial uses present;
- Requirements for limiting vegetation and ground disturbance within specific widths along certain water categories;
- Restrictions on felling, yarding, and road construction near these waters;
- Requirements for overstory and/or understory canopy retention to meet protection objectives such as temperature control or bank stability;
- Conifer and snag retention for wildlife habitat and aquatic coarse woody debris deposition;
- Provisions for allowing site-specific exceptions to the rules if an equal or greater level of protection can be ensured.

Each state has chosen different techniques to deal with these elements of riparian protection. These variations may be more a result of differences in the political climate in the three states than differences in riparian resources or harvesting techniques.

The forest practice rules in Oregon, Washington, and California reflect our state-of-the-art knowledge of riparian resource protection. Nevertheless, some of these regulations were written without a firm technical basis and are more the result of political compromise. Because of this and other reasons, all three states are now developing methods to monitor the effectiveness of their respective riparian rules. In this process, public involvement is seen as a key factor in ensuring credible and accepted monitoring results are produced. An end-product of monitoring, coupled with ongoing research, will be a more technically based justification for retention or revision of the current rules. Monitoring may also help to identify the costs and benefits derived from these regulations.

In Oregon, monitoring will concentrate on documenting the pre-operation and post-operation riparian conditions on a sample of harvest units representing the diverse forest riparian conditions in the state. The data collection effort will provide quantitative data on the immediate changes to riparian areas as a result of logging and the cost of the regulations to the forest landowners. It will enable the Board of Forestry to make a short term evaluation of the adequacy of the rules. A key step for the Board in judging the adequacy of the rules will be to clearly define the desired resource conditions that these rules are intended to maintain.

Fully determining the effectiveness of the riparian regulations and their resulting benefits, however, will ultimately require a long term research commitment beyond the scope or resources of the monitoring program. Both COPE and Washington's Timber/Fish/Wildlife Program include timely riparian research efforts which will allow us to obtain answers to some of the still unanswered questions. Close coordination between state agencies, researchers, and forest landowners in Oregon, Washington, and California must continue as we jointly work to find the best ways to manage and protect these important components of our forests.

Attachment: "Riparian Protection". Forest Practices Notes, Number 6. Oregon State Department of Forestry. October, 1987.

Forest Practices Notes

No. 6
October, 1987

Published by the Forest Practices Section
Oregon Department of Forestry
2600 State Street • Salem, Oregon • 97310

Riparian Protection

What Are Riparian Areas?

The wet soil areas next to streams, lakes, estuaries and wetlands are known as "riparian" areas. These are areas that have high water tables and soils which exhibit characteristics of wetness. Riparian areas often contain water-loving trees such as alder, willow, cottonwood, cedar and spruce.

Who Must Protect Riparian Areas?

Every forest landowner and any logger or commercial forest operator working on private forest land in Oregon is responsible for protecting riparian areas. The Board of Forestry developed new regulations to protect these important forest lands that went into effect August 1, 1987.

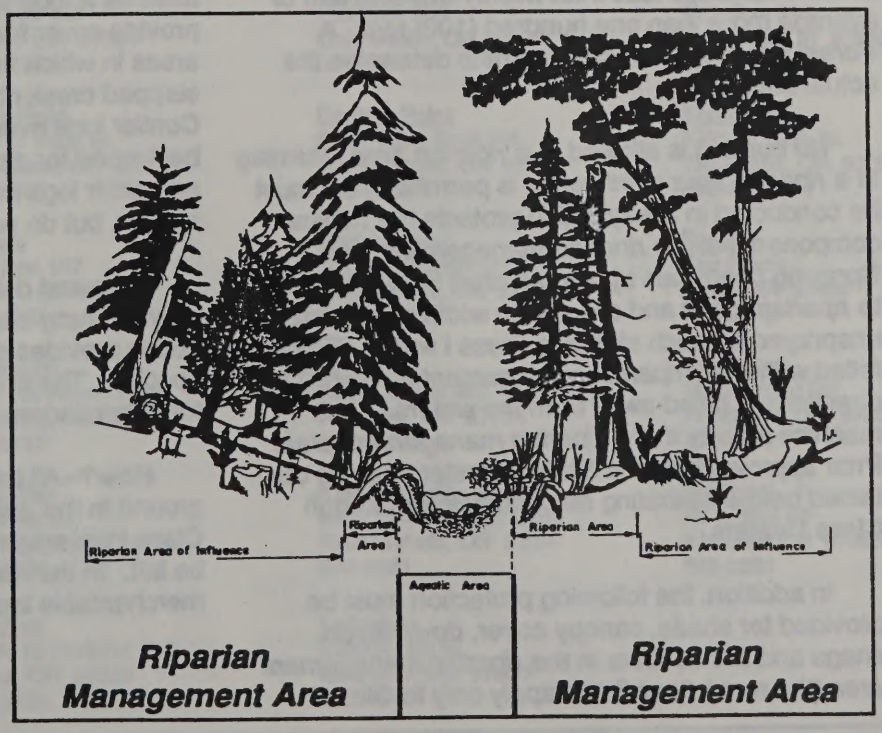
A *Forest Practices Forester* from the Oregon Department of Forestry will be available to help you protect these areas on your land. As a landowner or logging operator the law requires that you notify the Department of Forestry at least 15 days in advance of beginning any commercial operation on private forest lands in Oregon. Sometime beginning in 1988 a written plan describing your operation will be required when you conduct operations within 100 feet of a Class I stream.

A list of the Department's field offices and phone numbers is included on the back page. The information here provides an overview of regulations. Contact the Department of Forestry for more information.

Riparian Area Protection

Why?--Riparian areas make up only a small percentage of Oregon's total forest area, but when it comes to water, fish and wildlife it's a very important part. Riparian areas play an important role in protecting water quality and fish populations. Wildlife often find all of the necessities of life there.

Grasses, brush and trees growing on stream banks hold soil in place and filter water flowing to the stream. If a large amount of silt enters the stream it could smother fish eggs or insects the fish feed on in the stream bed gravel.



The log in this riparian area creates a pool behind it. The brush and trees provide shade and habitat for wildlife.

Wildlife is more abundant in riparian areas than any other part of the forest. Birds, rodents, amphibians, big game and other animals find water, food, nesting areas and cover, for protection from predators, man and the elements, in riparian areas. The corridors of brush and trees along streams provide a protected migration route for wildlife.

How?--A *riparian management area* shall be maintained along each side of all Class I waters. The size of the *riparian management area* shall be an average of three (3) times the stream width, but it shall not average less than twenty-five (25) feet or average more than one hundred (100) feet. A *Forest Practices Forester* can help determine the actual boundary.

No burning is allowed in a *riparian area*. Burning in a *riparian area of influence* is permitted, but must be conducted in a way which protects the habitat components of the *riparian management area*. Spraying chemicals by aircraft shall be done parallel to *riparian areas* and one swath width shall remain unsprayed on each side of a Class I water. Timber felled within the *riparian management area* shall be directionally felled away from the waters. Limit machine activity in the *riparian management area*. Prior approval from the State Forester must be obtained before operating machinery in or through Class I waters.

In addition, the following protection must be provided for shade, canopy cover, down wood, snags and live conifers in the *riparian management area* (the restrictions listed apply only to Class I waters, with the exception of shade protection which also includes Class II SP waters):

Shade Protection

Why?--Shade is necessary to protect water temperatures in streams. Trout and salmon prefer cool temperatures. If the stream is exposed to direct sunlight the water temperature will rise, which in turn could adversely affect fish populations.

How?--When logging on Class I and Class II SP waters the landowner or operator must leave 75% of the shade that existed over the *aquatic area* prior to the operation.

Canopy Protection

Why?--The leaves and twigs overhanging streams and lakes provide a major source of insects and organic materials essential to enrich streams and provide food for fish.

How?--When logging, the landowner or operator must leave 50% of the tree canopy in the *riparian area* that was present prior to the operation.

Down Wood Protection

Why?--Large logs left in the stream are important because they create pools, trap gravel moving down the stream in the bottom of those pools, hold organic matter in place, such as leaves and needles used as a food source by insects in the stream, and provide cover for fish. These pools create excellent areas in which fish can spawn and develop. A stair-stepped creek channel is the most productive. Conifer logs over 14 inches in diameter provide the best wood for dams to create pools. Large maple and alder logs also provide good structure to the stream, but do not last as long as conifers.

Logs and debris left above the water level provide many benefits for wildlife. This large wood debris provides dens and burrows for many small species. The rotten wood provides food and habitat for salamanders and other reptiles.

How?--All timber that was down and on the ground in the *aquatic area* and *riparian area* along Class I waters prior to beginning the operation must be left. In the *riparian area of influence* leave all unmerchantable logs.

How?--Live conifer trees must be left in the *riparian management area* along Class I waters, according to the table at right. These leave trees shall be left in the half of the *riparian management area* closest to the stream or within an average of 25 feet of the water, whichever is greater. The conifers left must be a minimum of eight (8) inches in diameter breast high, comprising at least ten (10) square feet of basal area per acre in the aggregate. In computing basal area, trees over twenty (20) inches diameter breast high shall be counted only as twenty (20) inch diameter trees. The trees left may be cull or nonmerchantable and may also meet the requirements for shade and stream canopy cover. Forest lands in the Eastern Oregon Forest Practices Region are not included in rules requiring live conifers in *riparian management areas* because sufficient conifers are left during selective harvest.

Table of Leave Trees

Average Stream Width	Average Rip. Mgt. Area Width	Conifers Per 1,000 Ft.	Basal Area Per 1,000 Ft.
8- Feet	25 Feet	5	6
10 Feet	30 Feet	6	7
12 Feet	35 Feet	7	8
13 Feet	40 Feet	8	9
15 Feet	45 Feet	9	10
17 Feet	50 Feet	10	11
18 Feet	55 Feet	11	12
20 Feet	60 Feet	12	13
22 Feet	65 Feet	13	14
23 Feet	70 Feet	14	15
25 Feet	75 Feet	15	16
27 Feet	80 Feet	15	17
28 Feet	85 Feet	16	18
30 Feet	90 Feet	17	19
32 Feet	95 Feet	19	21
33+ Feet	100 Feet	21	23

Where To Call: ODOF Field Offices

If you're planning to harvest timber, apply chemicals or conduct other forest operations on your forest land you are required by law to notify the Oregon Department of Forestry at least 15 days in advance of beginning that work. Department of Forestry offices are listed below. Local Forest Practices Foresters are available to review your planned operation to assure it meets the requirements of the Oregon Forest Practices Act.

Astoria
Route 1, Box 950
Astoria, OR 97103
325-5451

Columbia City
405 E. Street
Columbia City, OR 97018
397-2636

Tillamook
4907 E. Third Street
Tillamook, OR 97141
842-2545

Forest Grove
801 Gales Creek Road
Forest Grove, OR 97116
357-2191

Molalla
14995 S. Hwy. 211
Molalla, OR 97038
829-2216

Sweet Home
4690 Highway 20
Sweet Home, OR 97386
367-6108

Philomath
Star Rt., Box 1B
Philomath, OR 97370
929-3266

Dallas
825 Oak Villa
Dallas, OR 97338
623-8146

Toledo
P.O. Box 160
Toledo, OR 97391
336-2273

Springfield
3150 E. Main St.
Springfield, OR 97477
726-3588

Veneta
P.O. box 157
Veneta, OR 97487
935-2283

Roseburg
1758 NE Airport Road
Roseburg, OR 97470
440-3412

Coos Bay
300 Fifth St.
Coos Bay, OR 97420
267-4136

Mehama
22965 N. Fork Rd. S.E.
Lyons, OR 97358
859-2151

Bridge
Bridge Rt., Box 57A
Myrtle Point, OR 97458
572-2796

Gold Beach
P.O. Box 603
Gold Beach, OR 97444
247-6565

Central Point
5286 Table Rock Rd.
Central Point, OR 97502
664-3328

Grants Pass
5375 Monument Dr.
Grants Pass, OR 97526
474-3152

Prineville
Route 2, Box 357
Prineville, OR 97754
447-5658

Klamath Falls
3400 Greensprings Drive
KlamathFalls, OR 97601
883-5681

Lakeview
2290 N. 4th St.
Lakeview, OR 97630
947-3311

La Grande
E. Adams at 20th
La Grande, OR 97850
963-3168

John Day
P.O. Box 546
John Day, OR 97845
575-1139

The Dalles
3701 W. 13th St.
The Dalles, OR 97058
296-4626

Fossil
Star Route
Fossil,OR 97830
763-2575

Pendleton
1055 Airport Rd.
Pendleton, OR 97801
276-3491

Wallowa
Rt. 1, Box 80
Wallowa, OR 97885
886-2881

Snag Protection

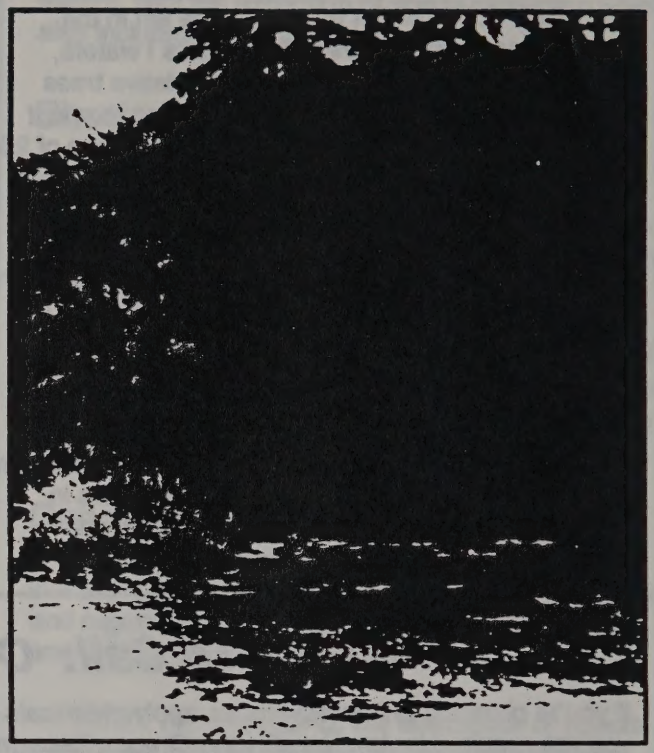
Why?--Standing dead trees or snags provide valuable habitat for insects, birds and small animals. Snags also provide future down logs for wildlife habitat and future logs in streams to create pools for fish habitat.

How?--Except for snags defined to be a safety hazard by the rules of Workers' Compensation Department, Accident Prevention Division or a fire hazard by the State Forester, leave all snags in the *aquatic area* and *riparian management area* along Class I waters.

Live Conifer Protection

Why?--Snags, down logs and logs creating pools in streams will eventually rot and disappear from the *riparian management area*. It's important that some live conifer trees be left to eventually die and provide future snags, down logs and logs in streams. For that reason the new rules require some live conifer trees be left in *riparian management areas*.

(Continued on back page)



This photo shows live conifers left in a clump along a Class I stream. Clumping conifers is preferred because it provides better habitat for wildlife.

Glossary of Terms You'll Need to Know

Class I Waters--These are the most important streams, lakes, estuaries and wetlands because of their fishery, domestic use and recreational values. These Class I waters include the water and banks below the normal high water level. Each Department of Forestry field office has maps showing the classification of waters of the state.

Class II Special Protection Waters--These are Class II waters that have a significant impact on Class I streams downstream. These waters have a significant summertime cooling influence on downstream Class I waters which are at or near a temperature at which production of anadromous or game fish is limited.

Class II Waters--These are any waters in the state that are not classified as Class I Waters, but which have a definite channel or bed. They are measured from the bank below the normal high water level.

Aquatic Area--This is the water area of a stream, lake or wetland measured at the high water level.

Riparian Area--Riparian areas are the wet soil areas next to streams, lakes,estuaries and wetlands. These areas have high water tables and soils which exhibit characteristics of wetness. Water-loving plants are often associated with these areas.

Riparian Area of Influence--This is a transition area between the riparian area and upland vegetation. It forms the outer edge of the riparian management area. It contains trees which may provide shade or contribute fine or large woody material or terrestrial insects to a stream. It also may contain trees that provide habitat for wildlife associated with the riparian management area.

Riparian Management Areas--This is the area the Board of Forestry has decided must be managed for protection of riparian values along Class I waters. Its width on each side of a stream shall average three (3) times the stream width, but shall not average less than twenty-five (25) feet or average more than one hundred (100) feet. A riparian management area occurs on each side of a stream and usually includes a riparian area and riparian area of influence. The width may vary with terrain and circumstances. The measurement is the average width over the length of stream where the operation occurs.

Forest Practices Forester--The Forest Practices Forester is an employe of the Oregon Department of Forestry and plays a key role in making the Oregon Forest Practices Act work on the ground. The FPF visits operations on the ground before, during and after operations to assist operators and landowners comply with the law through education and where necessary enforcement.

Buffer Strip Blowdown in the Oregon Coast Range

Hank Froehlich and Chip Andrus

I. Objectives

A. Determine where and to what extent streamside leave areas have suffered wind damage.

B. Determine the stand and site conditions associated with wind damage and develop a method to estimate risk of blowdown.

C. Determine the potential for increased sedimentation due to wind damage of buffer strips.

II. Methods

A. Reconnaissance of areas where wind damage was reported to be relatively frequent.

B. Intensive study of 30 buffer strips representative of leave areas required under current Oregon Forest Practice Rules.

III. Results

A. Mortality

1. Buffer damage during logging and slash burning was usually minor. Most losses of trees from riparian leave areas were due to wind.

2. Few trees have been harvested within buffer boundaries. Only 23 trees out of more than 9,000 trees included in these buffer strips had been cut.

3. Losses in basal area of because of wind ranged from 0 to 72%. Roughly half of the observed buffer strips had 20% or more of the initial basal area uprooted or snapped off.

4. Wide buffers were not any more windfirm than narrow buffers.

B. Species differences

1. Uprooting was the common type of wind damage for conifers; relatively few snapped off. About half of wind-damaged alders had their boles snapped off.

2. Western hemlock was most susceptible to blowdown.

3. Sitka spruce was particularly susceptible when growing on streamside terraces, but relatively windfirm on slopes.

4. Douglas-fir was more windfirm than other conifers, particularly on slopes.

5. Alder was somewhat more windfirm than hemlock and Sitka spruce, but less than Douglas-fir.

C. Canopy cover

1. Canopy density for buffers having little blowdown (<20%) averaged 80 percent.

2. Canopy density decreased in proportion to the basal area that was wind-damaged.

D. Direction of damaging winds

1. The direction of fall of uprooted or snapped off trees indicated that damaging winds were often from the southwest.

2. At some sites local topography was able to shift the wind direction by up to 90 degrees.

E. Prediction of windthrow

1. An equation was developed to predict the percentage of live tree basal area in the initial buffer stand that will be uprooted or snapped off by wind. The equation applies only to the zone and the time period for which data was gathered. The multiple coefficient of determination (R^2) was 0.57.

Percent
Blowdown = -26.5
+0.892 x % of trees growing on boggy terraces
+0.421 x % of basal area that is conifer
+10.8 x orientation of stream
[0 if stream is flowing NE or SW]
[1 if stream is flowing SE or NW]
+12.8 x shape factor
[0 if topographic protection to the SW is available within one mile]
[1 if little topographic protection to the SW is available within one mile]

F. Delivery of woody debris to the channel

1. Only 58% of wind-damaged trees fell within the stream's high water marks.

2. Of those trees that fell within the high water marks over half were suspended above the water and therefore had no immediate effect on the channel.

3. The probability that a wind-damaged trees falls within the high water marks is:

Probability (%) = 87.5 - 0.705 x distance from stream centerline (ft)

G. Sedimentation

1. Of those trees within the high water marks, 21% were sources of accelerated sedimentation.

2. Most sediment is associated with root wads.

3. Uprooting on steep streamside slopes did not cause landslides.

4. Downed trees rarely caused major channel changes.

5. Only 7 of the 30 buffer strips had increases in annual sediment one percent or higher than estimated background values.

6. Two small streams with high blowdown losses had 12 and 21 percent increases in sediment over a two year period.

IV. Conclusions

1. Wind damage to buffers in the Coast Range during the last six years has been limited to a coastal band 10 to 20 miles wide.

2. It has been several years since high winds have hit the coast and thus we may be underestimating losses.

3. Wind damage to buffer strips is somewhat predictable but much variability exists.

4. Some salvage of blowdown, particularly of those trees that did not fall within the high water marks, can be justified. Intensive salvage logging of a wind-damaged buffer to eliminate a "mistake" is not justifiable.

5. The design of buffer strips should consider the stability of leave trees and potential effects downstream.

Riparian Zones as Viewed by a Logging Engineer

James E. Neuman, P.E.
Weyerhaeuser Co.

Timberland owners are beginning to realize that timber is no longer the only natural resource society wants them to manage. Because of this, logging along streams and rivers has come under increasing scrutiny and pressure in the Pacific Northwest as the unique functions and benefits of streamside areas have become more apparent. The timberland owners must now recognize the importance of riparian zones for providing a great diversity of wildlife habitat and protecting long-term habitat production for fish. Also as important is the continued growth and development of the forest products industry in the Pacific Northwest.

Laws and policies have evolved with an increasing awareness and understanding of the nature and functions of streamside areas. These laws and policies have sought to allow the forest products industry to operate at a profit. When locating a setting boundary along a riparian zone it is the logging engineer's responsibility for meeting both these criteria. No longer can a logging engineer be concerned only with the logging system and the cost per board foot, but he must also be aware of the potential impact the proposed logging will have on the riparian zone.

This requires the logging engineer not only to have an understanding of timber cutting methods and logging systems, but he also must be able to assess the wildlife and fish habitat provided by the riparian zone. Furthermore, he must be able to recognize when there would be a significant impact on the riparian zone and seek specialized expertise in such areas as soils, geology, hydrology, fisheries, and wildlife biology.

A drainage can no longer be logged in a piecemeal fashion. A long term drainage harvest plan is required, incorporating the wildlife and fish habitat provided by the riparian zone. This eliminates short sided planning, and requires the timber manager to look at the drainage for an entire rotation. Every setting must be analyzed not only from a logging and cost standpoint, but also from the habitat required by wildlife and fish.

The timber manager, forester, and logging engineer would benefit by including soil experts, geologists, hydrologists, and fish and wildlife habitat specialists in the formulation of a drainage harvest plan. These participants, recognizing each other's expertise, work together to protect the wildlife and fish habitat provided by the riparian zones. The participants would realize that any timber harvest plan would be dynamic with changes occurring during the life of the plan. With the participants being consulted, when these changes occur, there would be less chance of the riparian zone being damaged. This type of planning requires the participants to come to a consensus where everyone agrees to support the completed drainage plan.

Implementation of Streamside Leave Areas

By Christopher Roach, Siuslaw National Forest

A lawsuit brought against the Forest Service in 1984 by the National Wildlife Federation lead to a study on the effectiveness of headwall and streamside leave areas (SSLAs) for preventing landslides on the Mapleton Ranger District. Fred Swanson, PNW, and I conducted that study. My presentation focuses on the effectiveness of using SSLAs. From an operational point of view, I will show the importance of follow through from the planning stage to the implementation phase of SSLAs. There are also some silvicultural considerations I feel are needed for improving the health of riparian zones.

SSLAs have been widely implemented on the Mapleton District for many purposes. Intentional and unintentional modification affected vegetation in 34% of the area of SSLSAs sampled (45 clearcut units). The extent of modification decreased in the latter part of the 1975-1985 study period. Timber harvest, blowdown, and slides, in decreasing order of importance, have been the main causes of modification of SSLAs. We did not evaluate how this modification of vegetation affectsthe value of leave area functions. Average leave area width was 69 ft. on one side of streams. SSLAs occupied 8.4% of the area of clearcut units containing headwall leave areas.

Frequency of streamside slides (10 cu.yd. and greater) in forest, clearcut and leave areas ranged between 0.01 and 0.20 slides per 1000 feet of channel length. Sliding frequency was higher in SSLAs than in forested areas for first- through fourth-order channels, perhaps because standing trees in leave areas increase the potential for slides triggered by blowdown and by the effects of logging. The number of streamside slides was low and, with one exception, small in terms of volume of soil moved. None of the slides in the clearcut or SSLA zones triggered debris flows, but two debris flows were triggered by streamside slides in forest areas.

Thoroughness in planning and implementing each SSLA phase is required to obtain effective results. Ten steps to consider are: Identification - in the office and in the field; Evaluation - demonstrating its value to the IDT; Prescription - proper documentation in the EA; Layout; Contract specifications; Contact with the Timber Sale Officer and logging company representative; Cutting and bucking; Yarding; Burning; and Monitoring the results. The key step, which encompasses the entire implementation phase, is to work with the Timber Sale Officer. A rough study done at Mapleton indicated that even with follow up, an average of only 80% of what was originally planned was accomplished.

Riparian area wellness, like human wellness, should focus on future oriented, long term prevention of health problems rather than on mitigation or treatment of symptoms. Although more research is needed in this important area, the apparent key to riparian health is successful underplanting of conifer trees. Effective implementation of underplantings depends on proper site preparation, using an appropriate stock, fertilization, animal damage control, follow up release, adequate budgets and funding strategies.

Modeling Large Woody Debris Inputs to Streams from Riparian Management Areas

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(503) 753-5831

Summary

Coarse Woody Debris (CWD) inputs to streams are estimated using a simple theoretical model of tree-fall. The estimates are derived from the density (trees/area), size distribution, species distribution, and mortality rate of trees in the riparian stand.

Crude estimate of CWD input (Fig. 1)

Let: L = Length of stream reach.
D = Density (trees/area) of riparian stand.
H = Average height of riparian trees.
P_F = Probability of a randomly-selected tree falling within 10 yr.

Then, the mean number of trees falling into the stream reach, from both sides of the channel, over 1 decade is given by:

$$N = 2 \cdot D \cdot L \cdot H \cdot P_F \qquad (1)$$

Equation 1 assumes that all trees fall directly towards the channel. If trees instead fall in a random direction, then N is only 1/3 as large (Van Sickle and Gregory 1989).

Example - A proposed Oregon Forest Practice rule requires that 9 conifers/acre (DBH > 8") be left standing after harvest in Riparian Management Areas. How much CWD will these trees deliver to a stream over one decade?

The post-harvest stand density is 9 trees/acre = 22.2 trees/ha = .0022 trees/m^2. Assume that the average tree height in a 100-yr-old stand is 25m. Also assume that P_F = 0.10 ($\approx$ 1% annual mortality) and that all trees fall directly towards the channel. For a reach of length L = 1 km, the projected mean input over 1 decade is

$$N = 2 \cdot (.0022 \text{ trees/m}^2) \cdot (1000\text{m}) \cdot (25\text{m}) \cdot (0.1) = 11 \text{ trees}$$

If trees fall instead in a random direction, then the mean input is 11/3 = 3.7 trees.

More realistic estimates

A more elaborate CWD model (Van Sickle and Gregory 1989) provides estimates for:
- Mixed-height and mixed-species stands.
- Stand density and tree-fall probability variable over distance from channel.
- User-specified distribution of tree-fall directions.

The model predicts:
- Mean and variance of total number and volume of tree bole segments falling into a stream reach.
- Distributions of piece length, piece volume, and orientation to the channel, for all CWD inputs.
- Long-term inputs, when coupled to a stand growth model.

Application to buffer strip design

CWD inputs from buffer strips of various widths, relative to the input expected from an uncut stand, are predicted by the full model (Fig. 2). Tree fall direction is assumed random, and stand density and tree fall probability are assumed constant with respect to distance from the channel.

The mixed-height stand is assumed to have 41% hardwoods < 20 m tall, 32% hardwoods between 20 and 30 m, 17% conifers < 30 m and 10% conifers > 30 m. The uniform stand contains only 50-m trees, and both stands are assumed to border a 15-m-wide stream.

General conclusions:
-- Trees close to the channel contribute most of the wood input, due to the assumption of a random fall direction.
-- Trees close to the channel contribute a greater fraction of CWD input in shorter stands than they do in taller stands.
-- In any stand, the fraction the total volume input contributed by trees close to the channel is greater than fraction of total number input.

Application to proposed Washington Forest Practice Rules

The full model was used to predict CWD inputs from hypothetical riparian zones harvested in compliance with Washington Proposed Forest Practice rules (Table 1). In all the cases shown, the Proposed rules would result in reduced post-harvest input rates, because the rules permit buffer strip widths less than the height of the tallest trees in the stand, and they also permit selective cutting within buffer strips.

Recommended Reading

HARMON, M.E., J.F. FRANKLIN, F.J. SWANSON, P. SOLLINS, S.V. GREGORY, J.D. LATTIN, N.H. ANDERSON, S.P. CLINE, N.G. AUMEN, J.R. SEDELL, G.W. LIENKAEMPER, K. CROMACK JR., and K.W. CUMMINS. 1986. Ecology of coarse woody debris in temperate ecosystems. Adv. Ecol. Res. 15: 133-302.

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ECONOMIC ANALYSES OF THE VALUE OF LARGE WOODY DEBRIS AS SALMONID HABITAT IN COASTAL OREGON STREAMS

Robert House and Val Crispin

Bureau of Land Management
Salem District
1717 Fabry Road
Salem, OR 97306

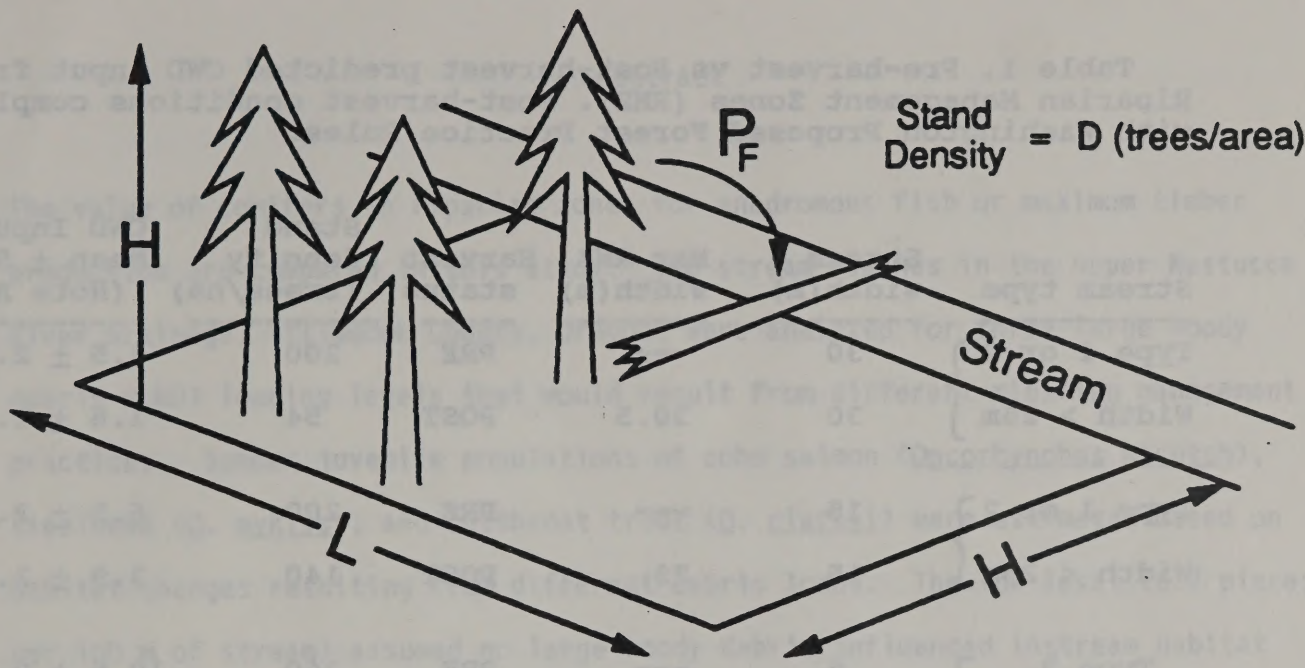

Fig. 1 - Model riparian zone for a uniform stand, height = H.

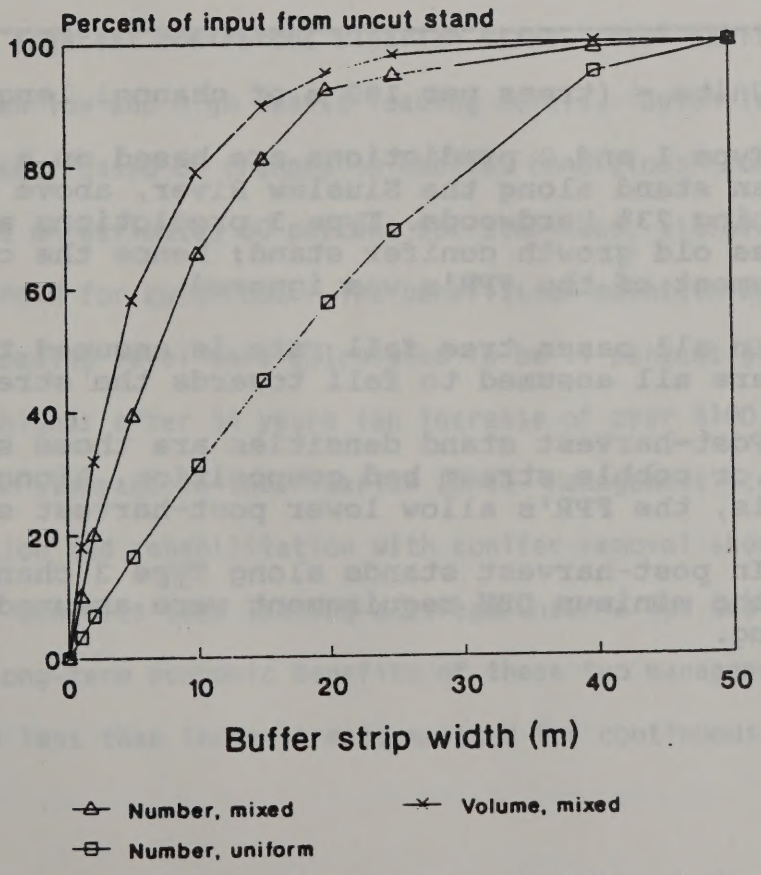

Fig. 2 - Post-harvest debris inputs from buffer strips of different widths, relative to pre-harvest input (uncut stand). For mixed-height and uniform height (H = 50 m) stands.

Table 1. Pre-harvest vs Post-harvest predicted CWD input from Riparian Management Zones (RMZ). Post-harvest conditions comply with Washington Proposed Forest Practice Rules.

Stream type	Stream width(m)	Max RMZ width(m)	Harvest status	Stand density (trees/ha)	CWD Input Mean ± SD (Note A)
Type 1 or 2	30	---	PRE	200	6.5 ± 2.4
Width > 25m	30	30.5	POST	54	1.6 ± 1.2
Type 1 or 2	15	---	PRE	200	6.5 ± 2.4
Width < 25m	15	23	POST	140	3.9 ± 1.9
Type 3	5	---	PRE	260	10.5 ± 3.1
Width >1.5m	5	15	POST	160	4.7 ± 2.0
Type 3	1	---	PRE	260	10.5 ± 3.1
Width <1.5m	1	8	POST	110	2.2 ± 1.4

Notes:

A) Units = (trees per 100 m of channel length, per decade).

B) Type 1 and 2 predictions are based on a 100 yr old riparian stand along the Siuslaw River, above North Cr., containing 73% hardwoods. Type 3 predictions are based on a Cascades old growth conifer stand; hence the conifer:hardwood requirement of the FPR's was ignored.

C) In all cases tree fall rate is assumed to be 1%/yr, and trees are all assumed to fall towards the stream.

D) Post-harvest stand densities are those specified for gravel or cobble stream bed composition. Along boulder or bedrock channels, the FPR's allow lower post-harvest stand densities.

E) In post-harvest stands along Type 3 channels, all trees below the minimum DBH requirement were assumed to be left standing.

Abstract

The value of conifers in riparian zones for anadromous fish or maximum timber production are compared in this study. Two stream reaches in the upper Nestucca River drainage, Tillamook County, Oregon, were analyzed for three large woody debris (LWD) loading levels that would result from different riparian management practices. Summer juvenile populations of coho salmon (Oncorhynchus kisutch), steelhead (O. mykiss), and cutthroat trout (O. clarkii) were estimated based on habitat changes resulting from different debris loads. The low level (0.7 pieces per 100 m of stream) assumed no large woody debris influenced instream habitat conditions, whereas the high level (11.0 pieces per 100 m of stream) was attained after artificially restructuring the channels with conifers taken mostly from the adjacent riparian zone. Catch estimates of mature salmon and trout were derived from summer juvenile populations and timber stumpage was based on values generated from the adjacent coniferous riparian stand. Pool habitat increased ~~fourteen~~ ten fold between low and high debris loading levels. Juvenile fish populations increases, based on changes in habitat conditions from low to high debris levels, were an estimated 60 percent for steelhead, sixfold for coho salmon, and twelvefold for cutthroat. The benefits of maintaining 2 km of stream at a high debris loading level were calculated to be 11 percent greater by year 20 and 59 percent higher after 94 years (an increase of over $100,000 in present value) over conifer stumpage in the riparian zone. Management scenarios for stream rehabilitation and rehabilitation with conifer removal showed greater short-term fishery benefits than leaving a stream under a low debris loading level. However, long-term economic benefits of these two management scenarios were substantially less than those streams managed for continuous high debris loading.

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Table 1. The amount, size, and type of large woody debris in 1,961 meters of the main channels in the Nestucca River and Elk Creek.

Woody debris	Debris loading			
	Controls[a/]	Low[b/]	Medium	High
Number of pieces				
Within high flow channel	---	14	55	216
Full spanning	---	0	2	30
Partial spanning	---	0	21	56
Pieces per 100 m	18.9	0.7	2.8	11.0
Pieces per 100 m influencing habitat conditions	---	0.0	1.2	4.4
Average diameter (cm)	71	50	50	60
Total length (m) per 100 m	56.8	70	243	2,096
Average length (m)	3.1	5.0	4.4	9.7

a/ - Results from inventoring 72.1 km on five streams located on BLM land within the Nestucca River drainage, 1984-1987.

b/ - Eliminates LWD that created pool and glide habitat in the pretreatment survey.

Table 2. Habitat changes and predicted salmonid production in 1,961 meters of the upper Nestucca River and Elk Creek under varying amounts of debris loading.

Variables	Large woody debris (#/100 m) 0.7	2.8	11.0
Habitat amounts (m^2)			
Pools	1,694	3,059	16,366
Glide	2,863	2,936	893
Riffles			
High gradient	1,289	1,289	890
Low gradient	8,073	6,282	3,768
Secondary channel	337	693	845
Total	14,256	14,256	22,762
Summer juveniles a/			
Coho	3,490	5,587	20,514
Steelhead (1+)	843	843	1,351
Cutthroat (1+)	20	46	249
Smolts b/			
Coho	1,554	2,488	9,133
Steelhead	421	421	676
Cutthroat	10	23	125
Adults c/			
Coho	116	187	685
Steelhead	43	43	68
Cutthroat	1.1	2.2	13.1

a/ Summer juvenile populations were estimated using the following densities in these habitat types:

	Nestucca River ($\#/m^2$)	Elk Creek ($\#/m^2$)
Coho Fry		
Pools and secondary channel riffles	1.0	1.5
Glides	0.2	0.8
High gradient riffles	0.05	0.4
Steelhead parr (all habitat types)	0.04	0.10
Cutthroat parr (pools only)	0.04	0.002

b/ Smolt numbers were determined using the following survival rates:

Coho salmon (Reeves et al 1989) -	June to September	0.84
	September to March	0.53
Steelhead and cutthroat parr -	Midsummer to March	0.50

c/ Smolt to adult survival rates:

Coho Salmon	0.075
Steelhead and cutthroat	0.10

Table 3. Estimated catch and annual net value of the anadromous fishery generated by 1,961 meters of upper Nestucca River and Elk Creek under varying amounts of debris loading.

Variables	Large woody debris (#/100 m) 0.7	2.8	11.0
Catch (numbers)[a/]			
Coho	80.0	129.0	473.0
Steelhead	17.0	17.0	28.0
Cutthroat	0.2	0.4	2.7
Fish values ($)[b/]			
Coho			
Commercial	614	986	3,628
Sport	816	1,322	4,826
Steelhead	1,759	1,759	2,897
Cutthroat	2	4	31
Total	3,191	4,071	11,382

a/ Catch was estimated at:

Coho salmon -	Commercial	48%
	Ocean sport	18%
	Inland sport	3%
Steelhead		40%
Cutthroat		20%

b/ Sport fish values were determined using:

	Angler-days/fish	Value/angler-day
Coho		
Ocean sport	0.8	40.28
Inland sport	3.3	13.06
Steelhead	4.0	25.86
Cutthroat	0.9	13.06

Table 4. The costs, annual benefits, and net present values (for 20,50 and 94 years) under different debris loads or management schemes for 2 km of the upper Nestucca River and Elk Creek.

Scenarios	Timber Harvest ($)	Project Cost ($)	Debris loading (#/100 m) 0.7 ($)	2.8 ($)	11.0 ($)
Channel wood		---			
Annual benefits ($)			3,191	4,071	11,382
Net present values ($)					
20 years			43,367	55,326	154,685
50 years			68,550	87,454	244,510
94 years			77,776	99,225	277,421
Conifer removal a/	100,051				
Annual benefits ($)			3,191	---	---
Net present values ($)					
20 years			139,570	---	---
50 years			164,753	---	---
94 years			173,979	---	---
Rehabilitation b/		46,200			
Annual benefits ($)			4,071 to 11,382		
Net present values ($)					
20 years			---	---	89,973
50 years			---	122,101	---
94 years			---	133,872	---
Conifer removal with rehabilitation c/	90,151	46,200			
Annual benefits ($)			3,191 to 11,382		
Net present values ($)					
20 years			---	---	174,215
50 years			199,398	---	---
94 years			208,625	---	---

a/ Conifer values for 7.8 hectares of a 94-year riparian zone (Androus and Forehlich 1987)

b/ Contract costs (log material not included) and annual benefits under the following assumptions:

0-3 years	$4,071
4-20 years	$11,382
21-94 years	$3,191

c/ Net conifer values (including log material used for structures) and annual benefits under the following assumptions:

0-3 years	$3,191
4-20 years	$11,382
21-94 years	$3,191

PANEL DISCUSSION: RIPARIAN AREA MANAGEMENT - PAST, PRESENT, AND FUTURE

MODERATOR: BOB BESCHTA, OSU FOREST ENGINEERING DEPARTMENT

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ODFW PERSPECTIVE OF THE NEW FPA RIPARIAN RULES

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Coordination between ODFW and DOF

Offices are often shared; FPA requires consultation with other agencies; ODFW field offices review notifications and provide written or verbal recommendations.

Positive changes in new rules

Rules now have measurable standards and specific rules; rules recognize broader resource values including some wildlife protection; there is now more consistency in rule application; a riparian management area concept was adopted; definition of Class I streams was broadened to include lakes, estuaries and some wetlands.

Technical concerns

Stream classification process is now more time consuming; the conifer retention standard may not provide woody debris at natural levels; retention of small conifers can meet the rules while the objective is for large conifers instream; the Class II SP rule has yet to be implemented.

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- Bureau of Land Management
- Pacific Northwest Research Station
- Siskiyou National Forest
- Siuslaw National Forest
- U.S. Fish and Wildlife Service

State Agencies
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- Department of Fish and Wildlife
- Department of Forestry
- Department of Land Conservation
- Division of State Lands
- Oregon State University

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- Oregon Coastal Zone Management Association

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